SCIENCE ABSTRACTS

SECTION A

PHYSICS.

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The Author and Subject Index for 1930 will be issued with the February Number.

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SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JANUARY, 1931.

GENERAL PHYSICS.

1. Action of Certain Gas Blowers. G. Bozza. *Accad. Lincei, Atti*, 12. *pp.* 47–54, *July*, 1930.—A mathematical treatment is given of the action and effects of the continuous introduction of a gas subdivided into bubbles in the lower part of a tube immersed in a liquid and open at both ends. Within certain limits of the ratio between the length of the immersed part of the tube and its total length, a continuous flow of liquid mixed with gas is established, the phenomenon being utilised for raising the liquid or merely for circulating it within a vessel. T. H. P.

2. Precise Measurement of Short Time-Intervals with the Microchronographic Wheel. G. R. Town. *Rev. Sci. Instruments*, 1. *pp.* 449–465, *Aug.*, 1930.—Apparatus and methods are described by which time-intervals may be measured to a precision of 20 microseconds. The duration of the time-interval may be anything between 20 microseconds and 10 seconds or even longer. The record obtained is continuous, making it possible to locate any event within the time-interval to this same precision. The method is not limited to the measurement of electrical quantities. The application of the method to the determination of the speed of a rotating shaft is given in detail. AUTHOR.

3. Sources of Error in the "Drop-Number" Method for Measuring Surface-Tension. H. Junker. *Kolloid Zeits.* 52. *pp.* 231–239, *Aug.*, 1930.—An investigation of the errors introduced into drop-number measurements by omitting to wipe the outside of the stalagmometer tube after dipping it into the stock of liquid under examination. L. V. C.

4. Capillary Retention of Liquids in Assemblages of Homogeneous Spheres. W. O. Smith, P. D. Foote and P. F. Busang. *Phys. Rev.* 36. *pp.* 524–530, *Aug.* 1, 1930.—The pore space in an assemblage of uniform spheres was initially filled with liquid. After very slow drainage the amount of liquid retained by the spheres was experimentally measured. The liquid is retained in the form of rings at the contacts of adjacent spheres. The radii of curvature of the ring surfaces are computed in terms of surface tension, grain radius and pressure drop across the liquid-vapour interface, permitting calculation of the volume retained per sphere contact. The number of contacts per unit volume of spheres is obtained from porosity measurements using the theory developed earlier. Computed and observed data on total volume of retained liquid are in agreement. AUTHORS.

5. Motion of Gas Bubbles in a Horizontal Flow of Liquid. J. Versluys. *K. Akad. Amsterdam, Proc.* 33. 6. *pp.* 587–588, 1930.—It is shown that where a liquid moves horizontally against a resistance, there must be differentials of pressure in order to maintain the motion and, in consequence, a gas bubble in the liquid will tend to move in the same direction as the liquid, but at a greater speed. This phenomenon is of some importance for the study of the flow of gas and liquid in a porous medium. H. H. Ho.

6. Energy-Exchange of Divergent Streams. R. Siegmund. *Phys. Zeits.* 31. *pp.* 774–775, *Aug.* 15, 1930.—Deals with a number of points in the theory given by H. Lorenz [see Abstract 1766 (1929)]. A short reply by **H. Lorenz** follows. F. S.

7. Induction of E.M.F.s in a Moving Liquid by a Magnetic Field, and its Application to an Investigation of the Flow of Liquids. E. J. Williams. *Phys. Soc., Proc.* 42. *pp.* 466–478; *Disc.*, 485–487, *Aug.* 15, 1930.—A magnetic field induces e.m.f.s in a moving liquid, and by investigation of the e.m.f.s produced by a known magnetic field it is possible to obtain information about the distribution of velocities in the liquid. Experiments on the flow through straight tubes show that potential differences of the order of 10^{-4} to 10^{-3} volt, set up by a magnetic field in a moving liquid consisting of an aqueous solution of copper sulphate, can be satisfactorily measured. Observations on the flow through curved tubes have also been made. [See also following Abstract.] AUTHOR.

8. Motion of a Liquid in an Enclosed Space. E. J. Williams. *Phys. Soc., Proc.* 42. *pp.* 479–485; *Disc.*, 485–487, *Aug.* 15, 1930.—The increase of resistance of a column of mercury in a magnetic field, found in experiments on this effect, is due to the internal motion of the liquid produced by the action of the Ampère forces between the magnetic field and the electric current traversing the mercury. The hydrodynamic significance of the results of such experiments is considered, and the consistency of the results shows that e.m.f.s as small as 10^{-6} to 10^{-7} volt, induced by a magnetic field in moving mercury, can be accurately measured. This result shows the practicability of the method of investigating the flow of liquids proposed. [See preceding Abstract.] AUTHOR.

9. Diffusion into an Infinite Plane Sheet. A. T. McKay. *Phys. Soc., Proc.* 42. *pp.* 547–555, *Aug.* 15, 1930.—The solution of the partial-differential diffusion equation for the infinite plane sheet is found by operational methods, subject to a surface condition analogous to Newton's law of cooling. By use of the fact that the area between the theoretical quantity/time curve, its asymptote and the quantity-axis is finite, a method of curve-fitting suitable to the case is suggested. To facilitate the application of the method to experimental data two numerical tables are appended. AUTHOR.

10. Tensions in an Elastic Medium. E. Volterra. *Accad. Lincei, Atti,* 11. *pp.* 964–968, *May* 30, 1930.—In a previous paper [see Abstract 3322 (1930)] the author studied the deformation of an elastic medium due to a small displacement of a rigid sphere imbedded in the medium. He now works out the tensions in the medium. He finds the three resultant components and the three resultant moments, when the characteristics of the motion of the sphere are given. A. D.

11. Influence of Nuclei Imbedded in an Elastic Medium. E. Volterra. *Accad. Lincei, Atti,* 11. *pp.* 1086–1089, *June* 15, 1930.—Develops the theory of the action of numerous rigid nuclei imbedded in an elastic medium to which they adhere, each nucleus being subject to rigid displacements which deform the elastic medium, and lead to a state of equilibrium. The result is that there are two systems of forces which have mutual relations analogous to those of electrostatic induction. A. D

12. Plane Motion of Isotropic Elastic Bodies. J. H. Ramström. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 22*a*. 6. [32 *pp.*], 1930. *In German.*—The general mathematical theory of the displacements and strains produced in a medium due to the plane motion of a body in the medium is developed. J. S. G. T.

13. Elastic Line of a Rod Loaded at the End. E. Callandreau. *Comptes Rendus,* 191. *pp.* 314–316, *Aug.* 18, 1930.—Studies the form assumed by a homogeneous rod of constant section, when acted on by a force at one end in the direction of the initial direction of the axis of the rod. The rod will, in general, bend into a wave-form, which may correspond to a single half wave, or to a number n of half wave-lengths. Euler's theory takes for the form of the elastic line (wave-form) a sinusoid, but the author's theory, which is more complete, and takes into account terms neglected by Euler, shows that this is not correct. H. N. A.

14. Intrinsic Stresses in Plane-Parallel Glass Plates and their Change on Fracture. M. v. Laue. *Zeits. f. techn. Physik* 11. 10. *pp.* 385–394, 1930. *From the Reichsanstalt.*—The distribution of stress in optical plane-parallel glass plates and its relation to the double refraction shown by the plates is discussed mathematically for the case of radial symmetry. The effect of fracture upon the distribution of stress and double refraction is similarly discussed. The work is of importance in connection with the trimming of such plates. J. S. G. T.

15. Photographic Study of Elasticity. E. Volterra. *Ingegnere,* 4. *pp.* 516–531, *Aug.*, 1930.—A discussion of the methods of studying strains by means of polarised light, with diagrams and coloured figures. E. E. F. d'A.

16. Vibrations of a Non-Planar Membrane. G. R. Stibitz. *Phys. Rev.* 36. *pp.* 513–523, *Aug.* 1, 1930.—Equations of motion are deduced for a non-planar membrane in small oscillation about any position of equilibrium. Cylindrical and conical membranes are discussed briefly as special cases; with certain types of boundary conditions there is no solution of the problem when stiffness is entirely omitted, and this is particularly true of the cone because of a characteristic singular point in the differential equations. AUTHOR.

17. Experiments on Cohesion. Part I. Method and Tensile Strength of Rock-Salt. H. Tertsch. *Zeits. f. Krist.* 74. 5–6. *pp.* 476–500, *Aug.*, 1930.—Apparatus is described designed to give an accurately measurable vertical pressure or blow. This is applied by means of a horizontal knife-edge or wedge (angle 60° or 90°) on a parallelepiped of rock-salt placed horizontally, and either completely supported on a table or lying evenly across a gap of accurately known and variable dimensions, the knife edge or wedge descending exactly on the centre line between the edges of the gap. In the present paper the

case of a steadily increasing pressure exerted on the rock-salt lying across a gap of width varying from 3 to 5 mm. is considered; the lower side of the parallelepiped is thus subjected to tension, and rupture begins there. Causes militating against and precautions necessary to secure approximately reproducible results are discussed at length. As a result of several hundred experiments, the load causing rupture is found to be proportional approximately to the cube of the thickness, but with considerable variation above and below the mean amount. A possible connection between this proportionality and the dilatation is then discussed. No definite relation between load and width of gap was found. A knife edge required a larger load to cause rupture than a wedge. Placing the rock-salt so that a cleavage plane was inclined not more than 10° to the edge of the wedge (or knife) had no effect on the load. C. A. S.

18. Plasticity of Rock-Salt, Silver Bromide and Silver Iodide at Different Temperatures. F. Rinne and W. Riezler. *Zeits. f. Physik*, 63. 11–12. *pp.* 752–759, 1930.—Instead of using a Brinell sphere for testing the "hardness" of these substances, the author uses Ludwig's test, in which a conical body is pressed down on the substance tested by a known force. The connection between the time t during which the pressure continued and the radius r of the impression made in the substance was investigated, and it was found that $r = k_1 + k_2 \log t$, where k_1 and k_2 are constants. The expression found, which included the effect of T, the temperature, was $r = \sqrt{\frac{1}{\pi}} P(c_1 + c_2 T + c_3 e^{bT} \log at)$, where P is the force acting on the cone and a, b, c_1, c_2, c_3 are five characteristic constants for the material tested. Tests have been made on pastilles made from the powdered substances as well as upon crystals. α and β silver iodide behave like different substances. H. N. A.

19. Recrystallisation of Compressed Rock-Salt. G. Ortner. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 5-6. *pp.* 271–274, 1930.—An investigation along similar lines to that of Przibram [see Abstract 105 (1930)], except that here the changes on compression are followed by X-rays throughout. Crystals from solution showed a marked increase in grain size a few hours after exposure to a pressure of 5000 kg./cm.^{2} and upwards. Crystals from the melt showed no effect four months after similar treatment. Signs of recrystallisation were obtained in powdered solution-crystals under high pressures. The compression apparatus was so arranged that the substance was under pressure for about a minute. No explanation is offered for the phenomena observed. F. I. G. R.

20. Cohesion Characteristics of Calcium Chloride Crystals. G. Heyse. *Zeits. f. Physik*, 63. 1–2. *pp.* 138–140, 1930.—Cleavage and fracture experiments with crystals of calcium chloride, prepared from a melt, gave results which are compatible with tetragonal symmetry of the crystals; the crystal structure is probably that of rutile. The tensile strength normal to the more perfect cleavage planes (100) is considerably smaller than that normal to the less perfect cleavage planes (001). J. S. G. T.

21. X-Ray Method for Quantitative Crystal Analysis. L. Grebe. *Zeits. f. techn. Physik*, 11. 10. *pp.* 428–429, 1930.—Essentially a comparison method, in which two Debye cameras are used, one on either side of an X-ray tube. One contains the body under test (in the form

of a small bar), and the other the same shaped specimen for comparison. The ratio of the intensities in the two cases is a linear function of the thickness of the bars. Results for various ceramics are given, which bear out the linear equation just mentioned. F. I. G. R.

22. Interpretation of X-Ray Single Crystal Rotation Photographs. W. Büssem and K. Herrmann. *Zeits. f. Krist.* 74. 5–6. *pp.* 437–457, *Aug.*, 1930.—Describes two simple developments of the crystal rotation method by which an unequivocal determination of the space-group can be made. Reciprocal lattice theory is used, and the use of the moving film technique is avoided. One of the methods was tested in a study of silver permanganate. [See following Abstract.] W. H. Ge.

23. Crystal Structure of Silver Permanganate. W. Büssem and K. Herrmann. *Zeits. f. Krist.* 74. 5–6. *pp.* 458-468, *Aug.*, 1930.—The X-ray single crystal rotation method [see preceding Abstract] was used, and from the photographs it was deduced that the unit cell of dimensions 5·66, 8·27 and 7·12 Å. and axial ratios $0·684 : 1 : 0·861 (\beta = 92° 29')$ contains 4 molecules of $AgMnO_4$. Space group C_{2h}^5 or in the new notation $C_{2h}pv2$. The structure of the related ABO_4-type compounds is discussed. W. H. Ge.

24. Crystal Structure of Fe_2P, Fe_2N, Fe_3N and FeB. S. B. Hendricks and P. R. Kosting. *Zeits. f. Krist.* 74. 5–6. *pp.* 511–533, *Aug.*, 1930. *In English.*—Analysis of the crystal structure of these compounds of a metal and a non-metal suggests that they are non-ionic coordination compounds. The probable extent and type of coordination are discussed for each case. The general characteristics of such compounds are: a polyhedron of metal atoms surrounds each non-metallic atom, the metallic atoms being equidistant from the non-metallic atoms. These polyhedra are regular or are distorted so that the metal atoms have, along some elements, the separation characteristic of the metal. If a compound R_aX_b consists of coordinated polyhedra having N corners, then each corner is shared by Nb/a polyhedra. The sharing is usually of corners only, sometimes of edges, and less often of faces. A. J. M.

25. Crystal Structure of Cadmium Chloride. L. Pauling and J. L. Hoard. *Zeits. f. Krist.* 74. 5–6. *pp.* 546–551, *Aug.*, 1930. *In English.*—Data obtained from Laue and oscillation photographs show that the unit of structure for $CdCl_2$ is a rhombohedron with $\alpha = 36° 02'$ and $a = 6·23$ Å., containing $1CdCl_2$, Cd at 000, 2Cl at uuu, $\bar{u}\bar{u}\bar{u}$, with $u = 0·25 \pm 0·01$. A layer structure along [0001], closely related to that of CdI_2, is found for $CdCl_2$, the Cl^- ions being in approximate cubic close packing. $MgCl_2$, $CoCl_2$, $NiCl_2$, $FeCl_2$, $MnCl_2$, $RuCl_2$, $RbCl_2$, $IrCl_2$, $PtCl_2$, $PdCl_2$ and $CdBr_2$ are representatives of the $CdCl_2$ structure; CoI_2, FeI_2, MnI_2, PbI_2, $CoBr_2$, $FeBr_2$, $MgBr_2$, $MnBr_2$ and $Mn(OH)_2$ of the CdI_2 structure. A. J. M.

26. Crystal Structure of Thiophene. G. Bruni and G. Natta. *Accad. Lincei, Atti*, 11. *pp.* 929–934, *May* 30, 1930.—X-ray measurements by the powder method by means of a special spectrograph adapted to low temperatures show that thiophene possesses a tetragonal cell with the axial ratio $a : c = 1 : 1·32$. At $-170°$ C. the lattice constants are $a = 7·225$, $c = 9·54 \pm 0·01$ Å., $v = 498·10^{-24}$ c.c.; the unit cell contains 4 molecules of C_4H_4S and the density is 1·11. In these measurements

use was made for the first time of the radiation from a metallic calcium antikathode, which is especially advantageous in the investigation of organic compounds. T. H. P.

27. Crystal Structure of Benzol. G. Bruni and G. Natta. *Accad. Lincei, Atti*, 11. *pp.* 1058–1062, *June* 15, 1930.—Benzol is examined by X-rays and the powder method at a temperature of −170° C. and using a metallic calcium antikathode. The density comes out as 1·099, and the ratio of the sides of the elementary crystal as 0·771 : 1 : 0·708. There is no true isomorphism between benzol and thiophene. E. E. F. d'A.

28. Crystal Structure of Zinc Orthotitanate and Orthostannate, and of Nickel Orthosilicate and Metatitanate. N. W. Taylor. *Zeits. f. phys. Chem.* 9. *Abt. B.* 4–5. *pp.* 241–264, *Aug.*, 1930.—On heating at 850–1000° for 24–150 hours one or two molecules of zinc, nickel or copper monoxide with one molecule of silicon, titanium or tin dioxide, the only compounds (apart from zinc silicate) obtainable are: (1) zinc orthotitanate, (2) zinc orthostannate, (3) nickel orthosilicate and (4) nickel metatitanate. None of the corresponding meta- or ortho-compounds, no nickel stannate, and no compound containing cupric oxide could be obtained in this way. Examined by the powder method, the following results were obtained: (1) cubic, spinelle type, a 8·460 ± 0·005, d 5·295; (2) cubic, spinelle type, a 8·650 ± 0·005, d 6·393; (3) rhombic, olivine type, a 4·705 ± 0·005, b 10·10 ± 0·02, c 5·914 ± 0·005, d 4·920; (4) rhombohedral, corundum type, r 5·440 ± 0·004, α 55° 0′; c/a 2·748, d 5·075. The radii of the nickel and magnesium ions being almost identical, the frequent occurrence of nickel in olivine in partial replacement of magnesium was to be expected. In regard to the failure to obtain any compound containing copper, it is to be noted that the ratio of the ionisation potential of Cu++ to that of Cu+ (2·64) is much greater than that for nickel (2·38) or zinc (1·91); and also that in nature copper occurs much more predominantly as sulphide than nickel, and still more so than zinc. Two new rules are given for determining the possible indices of cubic crystals. C. A. S.

29. Polar Properties of Single Crystals of Ice. J. M. Adams. *Roy. Soc., Proc.* 128. *pp.* 588–591, *Aug.* 5, 1930.—Compares the conclusions of Barnes [see Abstract 901 (1930)] as to the structure of ice crystals, arrived at by the X-ray method, with the results of observations on single crystals of simple forms, grown under controlled conditions. Some individual microscopic monocrystals were found which, although they had the simple external form of a short right hexagonal prism terminated by basal planes, gave evidence of polar structure. When the crystal was brought into an atmosphere favourable to disintegration a pit appeared at one end only of the c axis. Two other types of disintegration were observed in crystals of the same external form. These are explained as due to the possible modes of twinning of a polar crystal on the basal plane. The polarity of the ice crystal is ascribed to the asymmetric location of the hydrogen ions with respect to the basal plane. H. N. A.

30. Polymorphism of Sodium Sulphate. Part IV. X-Ray Analysis. F. C. Kracek and C. J. Ksanda. *J. Phys. Chem.* 34. *pp.* 1741–1744, *Aug.*, 1930.—It is observed that most crystalline substances have a tendency to exist in more than one allotropic form and that sodium sulphate has this to an unusual degree. Reference is made

to the work of Gibson [see Abstract 2089 (1930)]. The results of X-ray experiments are also given. The type of camera employed is described. The X-ray method has detected three forms of Na_2SO_4, namely, Na_2SO_4I, stable above 240°, Na_2SO_4 V or theonardite, stable at ordinary temperature and Na_2SO_4III, metastable below 185°, but inert, when dry at ordinary temperature. A Laue pattern for $Na_2SO_4 . 10H_2O$ is also given. J. K.

31. Stereochemistry of Crystal Compounds. Part I. Simple Compounds AB. P. Niggli. *Zeits. f. Krist.* 74. 3–4. *pp.* 375–432, *Aug.*, 1930.—The possible types of symmetry of compounds of the type AB are considered in detail. The paper does not lend itself to abstraction. T. H. P.

32. Connection between Vicinal Pyramids and the Habit of the Crystal. G. Kalb. *Zeits. f. Krist.* 74. 5–6. *pp.* 469–475, *Aug.*, 1930. —The close connection between the form of vicinal pyramids and the habit of the crystals on which they occur is demonstrated by examples (illustrated) of such occurrences on crystals of barytes (2 varieties), apophyllite (3 varieties), apatite (2 varieties), and vesuvianite and wiluite. [See Abstract 3018 (1930).] C. A. S.

33. Structure of Inert Gases. G. Natta and A. Nasini. *Accad. Lincei, Atti*, 11. *pp.* 1009–1011, *May* 30, 1930.—An attempt to determine the atomic structure of solidified noble gases. The data obtained for xenon are published. The gas was condensed in a capillary tube, the thickness of the solid layer being 0·004 cm. The side of the elementary cell appears to be 6·18 Å., and its volume $236 \cdot 10^{-24}$ c.c. The density of xenon at its boiling point is 3·06. E. E. F. d'A.

34. Density and Compressibility of Phosphine. Atomic Weight of Phosphorus. M. Ritchie. *Roy. Soc., Proc.* 128. *pp.* 551–579, *Aug.* 5, 1930.—Determinations of the density were carried out in the usual manner, with full precautions, by means of balanced density globes, at the pressures 1, $\frac{3}{4}$, $\frac{1}{2}$ and $\frac{1}{4}$ atmosphere. The normal density found was 1·5307, and the factor for compressibility between zero and one atmosphere pressure was found to be $(1 + \lambda) = 1 \cdot 0091$. The molar weight of phosphine is 34·000 and the atomic weight of phosphorus 30·977. The estimated accuracy is of the order of 1 in 10,000. Aston's value for the atomic weight is 30·982. H. N. A.

35. Theory and System of Molecular Forces. F. London. *Zeits. f. Physik*, 63. 3–4. *pp.* 245–279, 1930.—The molecular forces resolve into three actually different constituents, of which two, the Keesom "direction-effect" and the Debye "induction-effect," with due alteration of details, have already been investigated. As the third constituent of the reciprocal effect should be added the mutual short-period disturbance of the internal electronic motion of the molecules, which contribution makes the chief constituent of the molecular attraction with the simplest non-polar and also weakly polar molecules. The term "molecule" is used in its original narrow significance exclusively for an organisation of atoms which possess no free valencies. This view of the molecular attraction as a disturbance effect of the second order, in contrast to the chemical forces, is proved as strictly correct for the monatomic inert gases, for these gases have spherical symmetry. The earlier inevitable assumption of a quadrupole structure for the inert gases thus becomes

unnecessary. While the purely theoretical determination of the molecular forces treated as these effects of the second order is naturally almost out of the question, the forces can, on the other hand, be estimated on the basis of their theoretical connection with the *f*-values of the dispersion formula from optical measurements. The forces so calculated give, with the same accuracy as that with which they themselves have been ascertained, the van der Waals attraction member of the empirical equation of state. A table is given of the a-constants of the inert gases as theoretically calculated compared with experimental values. Similar data are also tabulated for diatomic molecules without dipole moment: H_2, N_2, O_2, Cl_2, CH_4, CO, HBr and HCl. T. B.

36. Existence of a Carbon Isotope of Mass 13. A. S. King and R. T. Birge. *Mount Wilson Observat. Contrib. No.* 402. *Astrophys. J.* 72. *pp.* 19–40, *July*, 1930.—A faint band structure with head at 4744·5 Å. occurring in electric furnace spectrograms when the Swan band is very intense are shown to be due to a molecule $C^{13}C^{12}$, this being the first evidence of the existence of the isotope C^{13}. The Swan band 4382 Å., the cyanogen bands 3883 Å. and 3590 Å., and the carbon monoxide bands between 1200 Å. and 1500 Å. are shown, by further experimental work and examination of older material, to have isotopic bands due to C^{13} being associated with them. From a detailed examination of the isotopic shift of the (1·0) band, the mass ratio of the two isotopes is shown to be 12 to 13, with an accuracy of 1 part in 10,000. The isotopic band due to the $C^{13}N^{14}$ molecule is also found in the cyanogen band 3883 Å., as well as in the furnace spectrum of the 3590 Å. band. The abundance of the C^{13} isotope compared with C^{12} is estimated at approximately 1 to 400, but the value appears to be dependent upon the method of excitation. Low-excitation sources, especially the N-type stars, are most effective in emitting the C^{13} spectrum. The furnace is also very effective, but the arc only gives evidence of one isotopic band. Finally, the conditions in these three sources are discussed with regard to their possible bearing upon the excitation of the C^{13} bands. R. C. F.

37. Representation of the Dynamic Properties of Molecules by Mechanical Models. C. F. Kettering, L. W. Shutts and D. H. Andrews. *Phys. Rev.* 36. *pp.* 531–543, *Aug.* 1, 1930.—Mechanical models have been constructed to represent the dynamical systems believed to exist in the molecule. Assuming that the intramolecular forces lie along lines associated with the chemical bonds, and that for small vibrations they obey Hooke's law and have the mechanical character of spiral springs, it is possible to get a picture of the forces and masses which can be represented on a large scale by steel balls and spiral springs. Models have been constructed for some of the simpler nonpolar molecules. They are found to have characteristic frequencies which correspond very closely to the frequencies observed in the Raman spectra, and it is possible by this means to identify the Raman lines with definite types of motion of particular atoms in the molecule. This substantiates the view that Raman lines correspond very closely to characteristic fundamental molecular frequencies. AUTHORS.

38. Relation between the Raman Spectra and the Structure of Organic Molecules. D. H. Andrews. *Phys. Rev.* 36. *pp.* 544–554, *Aug.* 1, 1930.—The following procedure is proposed for identifying the

type of vibration in the molecule to which an observed frequency in a Raman spectrum corresponds. It is assumed that the only forces acting between the atoms in the molecule are those produced by the chemical bonds, and that there is a restoring force if the bond is stretched or if the angle which the bond makes with the other bonds on an atom is altered from the normal equilibrium value. It is also assumed that all non-polar chemical bonds have the same force constants in organic compounds. The different frequencies observed in the Raman spectra may then be considered as due solely to the variation in mass of the atoms concerned and to their space relation to each other—that is, whether they are in a straight chain, a branching chain, a ring, etc. It is possible to calculate in this way the number of Raman lines which should be observed for any compound, and the frequencies they should have. There is fair agreement with the observed spectra, close enough so that the lines can be identified with different types of motion in the molecule. [See also following two Abstracts.] AUTHOR.

39. Elastic Character of the Homopolar Chemical Bond. R. C. Yates. *Phys. Rev.* 36. *pp.* 555–562, *Aug.* 1, 1930.—An attempt is made to obtain frequencies of internal vibrations of some organic molecules by the consideration of certain mechanical systems. The system of three particles is studied assuming the forces of restitution elastic. Certain proportionality constants are determined, using a representative compound, which characterise the single valence bond. Calculated wave-numbers for CO_2, CS_2, CH_2Cl_2, C_2H_5OH are compared with observed data from Raman spectra. [See also preceding Abstract and following Abstract.] AUTHOR.

40. Study of the Small Vibrations of Six Particles in a System Analogous to the Benzene Ring. R. C. Yates. *Phys. Rev.* 36. *pp.* 563–567, *Aug.*1, 1930. The system of six particles is allowed to vibrate under certain restrictions, assuming an elastic nature for the restoring forces. Frequencies of vibration are obtained and compared with Raman data lending some support to the Claus construction of the benzene molecule. [See also two preceding Abstracts.] AUTHOR.

41. Reflection of Hydrogen Atoms from Lithium Fluoride. H. Johnson. *Frank. Inst., J.* 210. *pp.* 135-152, *Aug.*, 1930.—The paper describes the phenomena associated with the reflection of a sharply defined beam of hydrogen atoms from a crystal of LiF. Of primary interest is the fact that the atoms show interference effects in agreement with the wave-mechanics theory and plane-grating diffraction patterns are photographed. Evidence of the thermal agitation of the surface ions is obtained from the diffuse reflection which surrounds the specular beam. AUTHOR.

42. Affinity of the Hydrogen Atom for Electrons According to Wave Mechanics. E. A. Hylleraas. *Zeits. f. Physik*, 63. 3-4. *pp.* 291–292, 1930.—The latest value given by Kasarnowsky for E_H is 0 ± 15 k.cal./mol., which does not disagree with the author's value 16 k.cal./mol.[see Abstract 2440 (1930)]. The existence of H^- in canal rays, while it supports a positive value for the electron affinity of hydrogen, is hardly a proof, since these may perhaps be different quantum states of the ion in a lattice and in canal rays. Notices the work of Bethe, previously overlooked, on the affinity of H^- for electrons, the value obtained

agreeing with the author's and fixing a lower limit. The author finally decides that the best value is $E_H = 16$ k.cal./mol. H. N. A.

43. Reciprocal Action between a Hydrogen Atom and a Helium Atom, and between Two Helium Atoms. G. Gentile. *Zeits. f. Physik*, 63. 11–12. *pp.* 795–802, 1930.—Calculates by means of wave mechanics the energy of reciprocal action between H and He atoms, and between two He atoms in the ground state. In both cases it is possible to draw diagrams showing the relation between the distance between the atoms and the energy (in volts). The error in the case of H and He is not greater than 5 %, and there is always repulsion between the two atoms. In the case of two He atoms it is necessary to consider, in addition to the homopolar repulsive energy, the attractive polarisation energy. By calculating the minimum of the whole of the energy of reciprocal action, the distance between the atoms in liquid helium has been found to be $5{\cdot}9a_0$. Slater [see Abstract 406 (1929)] gives $5{\cdot}6a_0$, and the experimental value is $6{\cdot}5a_0$. H. N. A.

44. Eigenvalue Problem for an Electron Dipole in an Atomic Field. K. Basu. *Zeits. f. Physik*, 63. 5–6. *pp.* 304–313, 1930.—It is assumed that the atomic field arises by the superposition of a Coulombian attraction and the field of a dipole so that the potential energy function for the electron becomes $V = -\frac{Ze^2}{r} - \frac{Le\cos\theta}{r^2}$, where L is the strength of the dipole. This is inserted in Schrödinger's wave equation giving $\nabla^2\psi + \frac{8\pi^2 m_0}{h^2}\left(E + \frac{Ze^2}{r} + \frac{Le\cos\theta}{r^2}\right)\psi = 0$, and the solution of the eigenvalue problem is investigated. Separation of the variables can be effected, and details of the solution are given. The only selection rule valid for this type of field is that for the magnetic quantum number $m \nearrow^{m} \searrow_{m+1}$ and it appears that the structure of spectral lines becomes increasingly more complicated in passing to higher levels. W. S. S.

45. Determination of the Distribution of Electricity in the Lithium Atom. B. Arakatzu and P. Scherrer. *Helv. Phys. Acta*, 3. 5–6. *pp.* 428–435, 1930. *In German.*—The scattering function of metallic lithium has been determined by the X-ray powder method. According to wave mechanics it is possible to obtain by means of this method information as to the distribution of the negative electricity $u(r)$ in the atom, regarded as dispersed continuously about the nucleus; and it is shown how $u(r)$ can be calculated from the scattering function. The scattering in solid lithium is mainly caused by the lithium ion, and that due to the conductivity electrons would be found in the continuous background alone if these were uniformly distributed through the crystal lattice. As a matter of fact, they are to some extent concentrated near the ions and they will have some effect on the intensity of the interference maxima. Neglecting this for the present, it is found that the experimental F curve, as far as it goes, agrees quite well with the atomic form factor calculated by means of wave mechanics, provided zero point energy is assumed to exist. H. N. A.

46. Invariance of the Canonical Exchange Relations. L. Rosenfeld. *Zeits. f. Physik*, 63. 7–8. *pp.* 574–575, 1930.—Corrects an

error in the proof of Heisenberg and Pauli of the invariance of the canonical exchange relations, with regard to the Lorentz group. A certain additional condition given by them proves to be unnecessary. H. N. A.

47. Relationship between the Cauchy-Riemann and Dirac Differential Equations. D. Iwanenko and K. Nikolsky. *Zeits. f. Physik*, 63. 1-2. *pp.* 129–137, 1930.—The ordinary Cauchy-Riemann differential equations are derived by linearising the quadratic Laplace equation. Dirac's equation, excluding the mass member, appears as the Cauchy-Riemann quaternionic condition. J. S. G. T.

48. Dirac's and Maxwell's Differential Equations. F. J. v. Wisniewski. *Zeits. f. Physik*, 63. 9–10. *pp.* 713–717, 1930.—The four-component vector $(\psi_1, \psi_2, \psi_3, \psi_4)$ of Dirac's theory satisfies (in free space) $\frac{1}{ic}\frac{\partial\psi_3}{\partial t} + i\frac{\partial\psi_4}{\partial x} + \frac{\partial\psi_4}{\partial y} + i\frac{\partial\psi_3}{\partial z} + \frac{2\pi mc}{h}\psi_1 = 0$ and three other similar equations. If the vector is also supposed to satisfy $\bar{\psi}_1\frac{\partial\psi_3}{\partial t} + \bar{\psi}_2\frac{\partial\psi_4}{\partial t} = \psi_3\frac{\partial\bar{\psi}_1}{\partial t} + \psi_4\frac{\partial\bar{\psi}_2}{\partial t}$ and three other similar equations, the complete system of eight differential equations can be thrown into the form of Maxwell's electromagnetic equations

$$\operatorname{div} \mathrm{E} = 4\pi\rho, \quad \operatorname{curl} \mathrm{E} = -\frac{1}{c}\frac{\partial \mathrm{H}}{\partial t},$$

$$\operatorname{div} \mathrm{H} = 0, \quad \operatorname{curl} \mathrm{H} = 4\pi\frac{u}{c} + \frac{1}{c}\frac{\partial \mathrm{E}}{\partial t},$$

where $\mathrm{E}_x = k\,i(\psi_1\bar{\psi}_4 + \psi_2\bar{\psi}_3 - \bar{\psi}_1\psi_4 - \psi_3\bar{\psi}_2)$, and similar equations hold for the other components of E and H, whilst ρ and u represent the probability density and probability current of Dirac's theory. The equations obtained in this way are interpreted as the equations of the electromagnetic field in the interior of an electron gas the " molecules " of which are electric and magnetic dipoles. W. S. S.

49. Solution of Dirac's Equations without Specialisation of the Dirac Operators. F. Sauter. *Zeits. f. Physik*, 63. 11–12. *pp.* 803–814, 1930.—A general method is given for the solution of Dirac's equations for the electron or any similar equations, without specifying the character of the Dirac operators except that they satisfy $\gamma_\nu^2 = 1$, $\gamma_\nu\gamma_\mu + \gamma_\mu\gamma_\nu = 0 (\mu \neq \nu)$. The method is applied to the special problems, electron in field-free space, Kepler problem, Zeeman effect, and is found to lead to the same results as obtained by Dirac using an explicit matrix representation of the operators. The advantage of the method is that it makes clear the important distinction between linearly independent and essentially different solutions. W. S. S.

50. The Virial Law. V. Fock. *Zeits. f. Physik*, 63. 11–12. *pp.* 855–858, 1930.—The virial law is deduced, in accordance with the principles of quantum mechanics, by application of the variation principle, and shown to be applicable to Dirac's equation. J. S. G. T.

51. Wave-Mechanics Calculation of the Grating Energy and Grating Constants of Lithium Hydride. E. A. Hylleraas. *Zeits. f. Physik*, 63. 11–12. *pp.* 771–794, 1930.—A mathematical treatment

based on wave mechanics, considering the structure as made up of two-electron ions [see Abstract 2440 (1930)]. The value for the grating energy agrees with that deduced from the Ewald theory and the grating spacing differs from the experimental by about 8 %. It is suggested that a closer examination of the eigenfunction of the system may be able to reconcile the spacing differences without affecting the grating energy. J. E.

52. Electron Properties. R. D. Kleeman. *Zeits. f. Physik*, 63. 11-12. *pp.* 859-863, 1930.—The possible properties which an electron or proton may possess, without contravening the known laws of nature, are described. G. C. McV.

53. Rotational Motion of Molecules in Crystals. L. Pauling. *Phys. Rev.* 36. *pp.* 430-443, *Aug.* 1, 1930.—Studies the motion of a diatomic molecule in a crystal by means of the wave equation, and shows that it may approach one of two limiting cases—oscillation or rotation. In I_2 the intermolecular forces, and the moment of inertia of the molecule, are large; and the eigenfunctions and energy levels approach those corresponding to oscillation about certain equilibrium orientations. In H_2 these quantities are small, and the eigenfunctions approximate to those for the free molecule, even in the lowest quantum state, and the molecules rotate. It is found that crystalline hydrogen, at temperatures below the melting point, is a nearly perfect solid solution of symmetric and antisymmetric molecules. An expression is found for the entropy of the solid at these temperatures, and another for temperatures in the neighbourhood of 5° K. A number of substances intermediate in their properties between hydrogen and iodine are considered; in these some of the molecules oscillate, whilst others rotate. H. N. A.

54. The Uncertainty Principle. E. Schrödinger. *Preuss. Akad. Wiss. Berlin, Ber.* 19. *pp.* 296-303, 1930.—An extension of Heisenberg's uncertainty principle to any pair of Hermitian operators, not necessarily conjugate. The product of the " uncertainties " in the values of the two operators appears in terms of average values of certain combinations of these operators, with arbitrary wave-functions. The theory is applied to the determination of the uncertainty, at time t, in the position of an electron moving under no forces, the initial impulse and position being given subject to the usual Heisenberg uncertainty relation. It is shown that the least uncertainty in the position at time t depends only on the square root of t, together with constants, and not on the initial impulse. If relativity is taken into account it can be shown that the uncertainty in the position of the particle vanishes when the velocity of the particle is that of light. The paper is mathematical. G. C. McV.

55. Classical Physics and Chemistry and the Principle of the Extreme Simplicity of their Fundamental Principles. L. Zehnder. *Zeits. f. Physik*, 63. 9-10. *pp.* 706-712, 1930.—The author states 10 postulates which, he considers, are logically involved in the extreme simplicity of the principles of classical physics, as opposed to the complicated character of modern physical theory, and which must be satisfied if classical theory is to survive. J. S. G. T.

METEOROLOGY, GEOPHYSICS, AND ASTROPHYSICS.

56. Measurement and Registration of Outgoing Effective Temperature Radiation. A. Angström. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 22. *B*. 1. [6 *pp*.] 1930. *In English*.—Observations were made in Switzerland at various high-level stations in August 1929 employing a modified pyrgeometer to determine whether factors other than temperature and humidity affect the outgoing radiation. The instrument was designed to (1) eliminate the influence of convection through the air on the readings or records and (2) eliminate or reduce the effect of diffused radiation of short wave-length. At night the effective temperature radiation is very constant under undisturbed conditions and a slight minimum is shown two hours before sunrise. In the day the main features follow the same laws as at night, temperature and humidity being the main factors and any secondary influence cannot be large. The observations are to be treated in detail later. R. S. R.

57. Radiative Diffusion in the Atmosphere. O. F. T. Roberts. *Roy. Soc. Edinburgh, Proc.* 50. 3. *pp*. 225–242, 1929–1930.—Recent papers on radiation in the atmosphere [see Abstract 2977 (1929)] have led the author to study the processes of long-wave, low-temperature radiation from the diffusion standpoint, the decrease of water-vapour with height being regarded as exponential and the temperature constant up to tropopause and then zero. The properties of the functions required in further work are studied and the expression for the upward flow of radiation is obtained in the form of a power series in the temperature gradient in the troposphere, the coefficient of the first power being defined as the "coefficient of radiative diffusion." A model atmosphere resembling fairly well the conditions in N.W. Europe is considered; the upward flow of radiation and the coefficient of radiative diffusion are calculated, Hettner's data as modified by Simpson being utilised. Finally, the effect of the heating of the ground during the day to a temperature above that of the air near by is investigated. H. H. Ho.

58. Effect of Ozone on the Temperature of the Upper Atmosphere. Part II. E. H. Gowan. *Roy. Soc., Proc.* 128. *pp*. 531–550, *Aug*. 5, 1930. The method described in an earlier paper [see Abstract 430 (1929)] is rendered more easy of solution by certain assumptions and allowance is made for diffusion of radiation from the earth. Preliminary estimates of the rate of cooling of the upper layers of the stratosphere and consideration of independent observational evidence of meteors lead to the belief that mixing of the constituents is general far above the tropopause. The radiation from the stratosphere must then be less and since the absorption of solar energy is the same, higher temperatures result. The maximum temperature attainable is investigated, this being governed by the rate of thermal decomposition of ozone and the rate at which ozone is formed in the atmosphere. The assumption of radiative equilibrium is re-examined in relation to convection being sufficient to ensure mixing and the idea is retained. The effect of water vapour distributions for (*a*) no convection and gases in gravitational equilibrium, and (*b*) enough convection to give a constant composition is illustrated by calculations for varying conditions. The effects of different

distributions and amounts of ozone and different zenithal angles of the sun are similarly treated. It is concluded that plausible distributions of ozone and water vapour provide the basis for a quantitative explanation of sound wave and meteor phenomena. R. S. R.

59. Calculations of Oscillatory Air and Water Flow. B. Haurwitz. *Gerlands Beitr. z. Geophys.* 27. 1. *pp.* 26–35, 1930.—The author shows that when determining the motions of the atmosphere and the hydrosphere, the use made of the differential equations in many earlier papers is inaccurate, since only the motion of a point mass is obtained. To treat a liquid or gas as a very large system of point masses is very difficult and more complicated than the use of hydrodynamical methods. One can transform the equations obtained by the point-mass method into the hydrodynamical equations only by assuming that the local derivatives of the velocity vanish, but this is incorrect and leads to the motion of a rigid body. The correct hydrodynamical treatment of the problem is given, with application of the perturbation equations of V. Bjerknes. R. S. R.

60. Simple Method of Investigating Evaporation from a Lake Surface. A. Sinjagin. *Gerlands Beitr. z. Geophys.* 27. 1. *pp.* 53–70, 1930.—The outflow from the lake is accurately determined at intervals of half an hour and upwards over a sufficient period, the meteorological elements being simultaneously observed. The data are plotted against time, and absolute variations in outflow thence deduced. In absence of precipitation in the case of a lake into which influx is wholly subterranean, the influx may be assumed to be constant over the period of observation; consequently the variations in outflow are entirely due to variations in amount of evaporation, and provide data for their determination. The method is exemplified by two days' actual observations on Lake Toroschin, 115 km. S.S.W. of Leningrad, and 66,000 m.^{2} in area. C. A. S.

61. Turbidity Factor, Water Vapour and Dust. Part I. K. Feussner and P. Dubois. *Gerlands Beitr. z. Geophys.* 27. 2 *pp.* 132-175, 1930.—Using recent measurements at the Smithsonian Institute, new values for the extinction coefficients have been used to calculate the turbidity factors for total, red and short-wave radiation. Corrections are applied for the ultra-violet and infra-red radiations. For total radiation the new value is 25–30 % higher. The turbidity factor for short-wave radiation has been defined anew. For comparison of turbidity conditions at different heights, a new turbidity factor is introduced. With a constant turbidity, virtual diurnal changes are obtained. The total radiation is almost free from these changes, but for red considerable changes occur necessitating the introduction of a meteorological factor (water vapour) to characterise the turbidity for this part of the spectrum. In tables and diagrams the intensities of these three kinds of radiation are given for various heights and water-vapour content in the atmosphere. On the basis of the water-vapour values a characteristic measure of dust turbidity has been obtained from the turbidity factor for short-wave radiation. Finally, measurements from Monte Rosa (4560 and 2900 m.), Taunus (800 m.), Frankfurt (100 m.) and Kabelvâg-Lofoten (0 m.) are given as examples. R. S. R.

62. Arago-Davy Double Thermometer as a Means of Measuring the Physioclimatic Effect of Radiation. M. Robitzsch. *Gerlands*

Beitr. z. Geophys. 27. 2. *pp.* 244–252, 1930.—This instrument, formerly used to measure radiation, but which, owing to the inaccurate results obtained, has long gone out of use, is now shown to be well adapted to the measurement of the physioclimatic effect of radiation. The author has devised a form thereof for this purpose, consisting essentially of a pair of thermometers with bulbs coated respectively with lamp black and plaster of paris, each bulb being enclosed in a vacuous glass bulb. The formula for the radiation S deduced is $S = C\,(dt_2 - dt_1)(T_i - T_i')/(a - b)dt_1 \,.\, dt_2$, where C is the ratio of heat capacity to surface for the thermometers; a, b are the absorption coefficients for the incident radiation of the two thermometers, varying with the wave-length of that radiation, but for which mean values are determinable; dt_1, dt_2 the times taken by the thermometers at the mean temperature to fall through 1°, the expression $(dt_2 - dt_1)/dt_1 \,.\, dt_2$ thus including the effect of air movement; T_i, T_i' the equilibrium temperatures of the thermometers as observed. Methods of calibration and further simplifications under certain circumstances are discussed, as also the connection of the results with those obtained with the katathermometer [see Abstract 2104 (1930)]. C. A. S.

63. Forecasting Weather Conditions for Several Days. J. M. Angervo. *Gerlands Beitr. z. Geophys.* 27. 3–4. *pp.* 258–311, 1930.—Using Dirichlet's definition, every scalar meteorological element (pressure, temperature, etc.) is a function of three space coordinates and the time, and when so expressed a basis of forecasting is provided. The author considers the determination of pressure, temperature and precipitation at any future instant. Since at the time of the forecast little is known of the vertical distribution of the elements, the functions can depend on only three variables. The coefficients of the functions must be obtained by numerical approximation. Expressions are given for (1) the position of the centre of a depression or anticyclone and are simplified for a symmetrical pressure distribution; (2) the duration of either position; (3) the temperature distribution; and (4) the distribution of precipitation. Examples are given to illustrate these calculations, using German synoptic weather charts. In a critical discussion of the results, methods by which better results may be obtained are indicated, when the meteorological, coded message gives more exact information. R. S. R.

64. Isostasy. A. Belluigi. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 2. *pp.* 141–148, 1930.—The influence of bodies, both deep-lying and superficial, upon gravity is further considered, and the application of the topographic correction is extended. The solution for the special case of a body in the form of a parallelepiped is given. [See also Abstract 2983 (1929).] W. A. R.

65. Isostasy and Gravity Anomalies. W. Heiskanen. *Gerlands Beitr. z. Geophys.* 26. 1. *pp.* 42–50, 1930.—The assumptions made in recent papers by Hopfner on gravity reductions and the figure of the earth and the gravity anomalies are shown by the use of values obtained by several other people in different parts of the earth to be unjustified. The deflection of the vertical is also not to be explained by Bruns' term, and the warping of the geoid, according to observation, is much smaller than Hopfner anticipated, while these observed values agree well with those calculated by isostasy. Prey's reduction is also dealt with. R. S. R.

66. Continental Drift. U. P. Lely. *Phys. Zeits.* 31. *pp.* 738–742, *Aug.* 1, 1930.—An experiment is described which throws light upon the behaviour of a body floating in a fluid medium under the action of gravity. The existence of forces acting both towards and away from the pole are revealed, and the effect on a floating object will depend upon its size and upon the height of its centre of gravity. W. A. R.

67. Origin of Continents. J. Geszti. *Gerlands Beitr. z. Geophys.* 27. 1. *pp.* 1–25, 1930.—In an early state the earth is supposed made up of sima masses surrounded by lighter molten sial masses. This concentric distribution of material was disturbed later, a crust of the lighter sial masses being formed. At present the continental masses consist mostly of sial, and at the bottom of the ocean it is mostly sima, a vertical separation having occurred, mainly by thermodynamic action. The elevation of continents is due to condensation of sima masses, especially at the instant of transition from liquid to crystalline state. The thermodynamic effect is considered due to want of homogeneity in the sial masses containing various admixed masses. Reference is made to similar effects in the sun such as sunspots, faculæ and protuberances referred to by Tammann.
R. S. R.

68. Convergence of Series for External Space Potential. F. Hopfner. *Gerlands Beitr. z. Geophys.* 27. 1. *pp.* 36–41, 1930.—The development of space potentials, according to a series of spherical harmonics, is of special importance in geophysics, since the validity of a number of fundamental facts such as Clairaut's and Bruns' theorems for the level surface at sea-level depends upon it. It is shown that this development for external space is convergent also for a certain region in the internal space of the attracting mass. R. S. R.

69. Development of the Wave Conception. Part IV. K. Uller. *Gerlands Beitr. z. Geophys,* 27. 1. *pp.* 71–101, 1930.—It is shown that the differential equation, derived in Part III [see Abstract 3072 (1930)] from the interference principle for plane and spherical waves of elementary variational form, may be rigorously integrated, and that two wave-forms are obtained. The structure of the α-waves depends on the arrangement of the wave surface immediately at the source, whereas in the β-waves the phase velocity is constant to the first order, but with an extinction function in conservative media. Phase velocity and extinction have spatial variations. In the wave-field regions of very high and very low field strength alternate. With spherical waves the field strength declines to a minimum and then increases. Source spheres are recognised which consist of a system of wave shells of constant thickness and of decreasing strength, whilst the energy does not uniformly alter with distance from the spheres. It is opined that the prototype of the atom is here in evidence. It is also shown how the Euler solution may be misunderstood, and how it has hindered the development of the wave conception. H. H. Ho.

70. First Movement During an Earthquake. M. Hasegawa. *Gerlands Beitr. z. Geophys,* 27. 1. *pp.* 102–125, 1930.—The quadrant distribution of tension and thrust during the initial movement in an earthquake as derived by Shida is discussed and its significance indicated. The nature of a fracture in the earth's interior is then described and a calculation made for a shear disturbance. The process of fracture is next examined and a schematic representation derived for the connection

between the displacement and the initial movement, the position of the fracture and mode lines being obtained. The cases of a collapse and explosion quake are considered. A Bibliography completes the paper.
H. H. Ho.

71. Long Wave in the First Phase of Some Seismograms. O. Somville. *Gerlands Beitr. z. Geophys.* 27. 3–4. *pp.* 437–442, 1930. *In French.*—Seismograms obtained at Taunus, Uccle and de Bilt Observatories during the time of the Italian earthquakes in 1928, 1929, 1930 and 1915, are reproduced. They exhibit a wave arriving near to the time of the primary wave, and it is shown by Galitzin pendulums for both the N.–S. and E.–W. components. The author calls this a PL wave (long wave of first phase). It is proposed to collect further observations before discussing the cause. R. S. R.

72. Electrostatic Field of the Sun Due to Its Corpuscular Rays. H. P. Berlage, Jr. *K. Akad. Amsterdam, Proc.* 33. 6. *pp.* 614–618, 1930.—An approximate analytical expression is found for the charge density and force of the electrostatic field at great distances from the sun, on the assumption that positively and negatively charged corpuscles are radially expelled by the sun, leaving it in equal and stationary amounts in all directions. The solution is different according as the stream of charged corpuscles is weak or strong. In the latter case the solution suggests certain cosmogonic consequences to be investigated later. [See following Abstract.] J. S. G. T.

73. Electrostatic Field of the Sun as a Factor in the Evolution of the Planets. H. P. Berlage, Jr. *K. Akad. Amsterdam, Proc.* 33. 7. *pp.* 719–722, 1930.—Cosmogonical consequences of the author's theory developed in a previous paper [see preceding Abstract] are here briefly discussed. It is suggested that the well-known progression of the radii of the planetary orbits is attributable to the radially periodic character of the solar electrostatic field. J. S. G. T.

74. Convection in the Sun's Atmosphere. A. Unsöld. *Zeits. f. Astrophysik*, 1. 2. *pp.* 138–148, 1930.—A formula giving the effective ratio of specific heats of the gas in the sun's atmosphere, in terms of the temperature and the degree of ionisation of the gas, is given. It is then shown that since the atmosphere of the sun consists mostly of hydrogen, the region between optical depths 2 and 30 must contain convection currents. These give rise to the granulated appearance of the sun's surface. The theory also gives a possible explanation of the origin of Novæ. G. C. McV.

75. Intensity Measurements of Fraunhofer Lines. M. Minnaert and G. F. W. Mulders. *Zeits. f. Astrophysik*, 1. 3. *pp.* 192–199, 1930.—Extends the measurements on Fraunhofer lines previously given [see Abstract 1804 (1929)], examining the intensities of forty-seven lines of the sun's spectrum between 5150 Å. and 5270 Å. It is necessary to standardise the Rowland scale in this region in order to ascertain what total energy in the lines in this scale has disappeared. The intensity of these lines is found to be 1·39 times higher than of those in the blue region previously examined. Combining the results obtained with those of Russell, Adams and Moore, the connection between the absorbed energy and the number of absorbing atoms N is approximately the same as previously obtained, there being, however, appreciable differences between the

two regions. Six multiplets separately examined indicate in their mean curves characteristic individual deviations. From a comparison of the contours of two lines of the green magnesium triplet, it is shown that only in the central parts of the lines do systematic deviations occur. R. C. F.

76. Continuous Spectrum of Corona. M. Minnaert. *Zeits. f. Astrophysik*, 1. 4. *pp.* 209–236, 1930. *In English.*—The theory of the corona, under the assumption that it is composed of free electrons, is developed. The electrons are assumed to scatter the photospheric light according to the classical formula. The exact expression for the scattering of one volume element is derived, taking account of the darkening of the sun's limb. Observations are analysed and the actual number of scattering electrons is calculated. From the observational material it is concluded, however, that the electrons cannot be free but must be bound, and consequently the temperature of the corona must be 3000°–4000° C. The possibility of the continuous spectrum being a recombination spectrum due to the presence of electrons and positive ions in the corona is discussed. Another possibility, *viz.*, that scattering and emission in the corona may be a single process of Raman type, for example, is examined and found improbable. G. C. McV.

77. Periodic Changes in Solar Corona. O. Bergstrand. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 22*A*. 1. [19 *pp.*], 1930. *In French.* —Ludendorff has measured the apparent coronal diameters of solar eclipse photographs taken since 1893, and has constructed "isophotes" or curves of intensity of coronal light. He finds, for eclipses near maximum sunspot activity, that there is very small flattening of the different isophotes, but considerable flattening for those near minimum. There is an essential difference between the equatorial and polar directions which the author explains, and from his measures of the 1914 corona, he has deduced the intensity of what he calls the "polar veil." Using Ludendorff's material, he concludes that in the equatorial region light intensity varies with the inverse square of the distance from the solar limb, and the same holds good for the polar region *after* allowing for the polar veil. He finds a value p which expresses the ratio of the true polar corona to the equatorial at any distance from the sun's limb; this value decreases during the phase of decreasing activity; increases until near maximum; and at maximum falls sharply to its minimum value. He also considers the relationship of coronal light to the two classes of prominence, and gives diagrams.

A. S. D. M.

78. Orbit of the Trans-Neptunian Planet. M. Pierucci. *Accad. Lincei, Atti*, 11. *pp.* 1091–1092, *June* 15, 1930.—Some years ago it was shown that if the inner and outer planets are grouped separately, their mean distances from the sun increase in arithmetical progression, with two gaps in the outer group. Thus, the number $0{\cdot}362 \times 1$ represents nearly the mean distance of Mercury in astronomical units, and when multiplied by 2, 3, 4, it gives very nearly the mean distances of Venus, Earth, Mars. The number $4{\cdot}96$ is slightly less than the distance of Jupiter, and multiplied by 2, 4, 6, it gives the distances of Saturn, Uranus and Neptune. This empirical law applies also to the satellites of each planet, and its mean error is lower than in any law previously suggested. The new trans-Neptunian planet has now been added to the list, and it is found that the law applies even more exactly than before. Using a

multiple of 8, the calculated distance comes out at 39·68, the observed being 40·15 units; and the mean error is only 4·33 %. M. A. E.

79. Orbit of the Trans-Neptunian Planet. T. Banachiewicz. *Comptes Rendus*, 191. *pp.* 319–321, *Aug.* 18, 1930.—The observations in March and April were insufficient to specify the orbit completely where any three observations were employed because of the doubt regarding the actual path of the planet in space. A new method is explained in which linear equations are deduced to give the coordinates and vectorial speed of the planet by considering the projection of this path on the earth. This method can disclose the nature of this planet's orbit from observations obtained in the first half of 1930, while all methods based on three observations necessarily lead to an accidental result. R. S. R.

80. Bergedorf Plate Measurements for the Zonal Undertaking of the Astronomical Society. R. Schorr and F. Dolberg. *Zeits. f. Instrumentenk.* 50. *pp.* 445–460, *Aug.*, 1930.—Measurements are to be made of the positions of stars within a region of 5° declination from the N. Pole from photographs obtained at Bonn, Hamburg-Bergedorf and Pulkowo. A full description is given of the new form of plate measurer employed, and the magnitude of the likely errors is discussed. R. S. R.

81. Dynamics of Spherical Star Clusters. O. Heckmann and H. Siedentopf. *Zeits. f. Astrophysik*, 1. 2. *pp.* 67–97, 1930.—An account of the observational data with regard to star clusters is given. It is followed by a review of previous theories of these systems, which lead to an estimate of the time of relaxation, the cluster being assumed to be very nearly in a statistically stationary state. From this estimate it follows that the interaction energy of the stars of the cluster is important and cannot be neglected as hitherto. Various considerations then lead to the conclusion that the cluster must be considered as embedded in an infinite field of fluid. It is then shown that the Newtonian theory of the potential of such a cluster is not satisfactory: for Poisson's equation must be substituted the first approximation of Einstein's equations of gravitation with the "cosmological" term. The authors can then show that the cluster must contain periodic variations of density, as one proceeds outwards, such as have been observed experimentally in open clusters. **Errata,** *ibid.* 1. 3. p. 208, 1930. G. C. McV.

82. Colour Frequency Function in Star Clusters. B. Sticker. *Zeits. f. Astrophysik*, 1. 3. *pp.* 174–191, 1930.—Analyses the colour frequency functions of spherical and open clusters, using a method previously used for local systems. The "typical" colour indices of the four spherical clusters M3, 13, 22 and 68 are given to approximately the same frequencies, these stars only differing fron one another by a constant. By this means it is shown that these star clusters exhibit a real similarity to those of the local star systems. For the nine open systems M11, 34, 36, 37, 52, 67, N.G.C.663, Plejaden and Hyaden, the smallest "typical" frequency is indicated most frequently, and this can be used as a good characteristic of each individual cluster. The relationships between "typical" colour indices and the galactic coordinates, distance and diameter show a close coordination with the galactic width, whilst for the others the coordination is not so marked. The most red cluster is apparently found in the highest galactic width, near to the centre of the system, and possesses the smallest diameter. **Errata,** *ibid.* 1. 4. p. 274, 1930. R. C. F.

83. Radial Velocities of Globular Clusters. E. v. d. Pahlen and E. Freundlich. *Zeits. f. Astrophysik*, 1. 3. *pp.* 200–207, 1930.—Discusses a publication of P. ten Bruggencate on the above subject [see Abstract 2483 (1930)], in which he states that the present authors are wrong in disagreeing with Strömberg's solution. The present authors correct an error in ten Bruggencate's publication regarding the so-termed K effect. Further, the position taken by the authors regarding the dynamical meaning of the K effect which is opposite to that of Oort is again briefly stated. R. C. F.

84. Spectral Type of the Components of a Double Star Determined with the Interferometer. M. Maggini. *Accad. Lincei, Atti*, 11. *pp.* 888–891, *May* 18, 1930.—It is shown that from the simple measurement of the "visibility" of the fringes at least in two different radiations the difference between the colour indices can be obtained and thence the difference in the spectral type of the two components of a close double star. J. J. S.

85. Variations in Light Colour and Radial Velocity of Y Sagittarii. P. ten Bruggencate. *Harvard Coll. Obs. Circ. No.* 351. [21 *pp.*], May, 1930.—This star is one of the most completely observed of all Cepheid variables, for the present discussion is based on 661 photographs and 166 spectrograms taken at Lembang (Java) in 1926 to 1928, 1422 Harvard photographs of 1900 to 1929, and 144 spectrograms taken at Lick and Mt. Wilson during the same period. It appears that although the period of light variation (nearly six days) has remained absolutely constant, the mean photographic brightness, the amplitude, and the colour have varied, and closely correlated changes have also taken place in the radial velocity curve. The bearing of this on the general problem of Cepheid variability is briefly discussed. M. A. E.

86. Spectrum of β Lyræ. F. E. Baxandall. *Solar Physics Obs. Cambridge, Ann.* 2. 1. [24 *pp.*], 1930.—Curtiss at Allegheny concluded that this star was composed of two bodies giving dark-line spectra (types B8 and B5) and a third giving bright lines. The author compares these conclusions with his observations since 1919. The author describes the oscillating B8 absorption spectrum which indicates an eclipse of this component at the principal minimum; the lines of the B5 spectrum, especially the strong line $\lambda 3964$ and the helium line $\lambda 4471 \cdot 5$; the undisplaced k line of ionised calcium and other slightly displaced lines; and the bright bands. The spectroscopic evidence suggests that the B5 star is the fainter and the more massive; that it is surrounded by a gaseous envelope which is fairly transparent to the B8 star light which is responsible for the bright band radiation and for the spectral anomalies by selective line absorption from this outer B5 envelope. He makes a tentative model to solve the β Lyræ problem through the presence of three bodies and puts forward the hypothesis of a Trojan planet; he also explains the hypothesis of a pulsating envelope round one of two stars. There are three plates as illustration. A. S. D. M.

87. More Complete Discussion of the Time Dependence of the Non-Static Line Element for the Universe. R. C. Tolman. *Nat. Acad. Sci., Proc.* 16. *pp.* 409–421, *June*, 1930.—In a previous paper [see Abstract 3093 (1930)] it was shown that by assuming a non-static line element of the form

$$ds^2 = -(dx^2 + dy^2 + dz^2)e^{g(t)}/(1 + r^2/4R^2)^2 + dt^2$$

it is possible to explain and correlate the continuous transformation of matter into radiation and the red shift in light from extra-galactic nebulæ. The results obtained were deduced, assuming $g(t) = 2kt$, and in the present paper the suitable form of $g(t)$ is given a fuller discussion as it appears that different approximations introduced to obtain usable results may affect quite differently the expressions for the relation between red shift and distance and for the rate of annihilation of matter. General considerations show that $g(t)$ cannot be a constant and must increase with time. By departing from strict linearity of $g(t)$ with respect to t, it appears that the theoretical relation between red shift and distance is still approximately linear (as found observationally), but a very considerable change is produced in the calculated rate of annihilation of matter. W. S. S.

88. Estimation of Distances in a Curved Universe with a Non-Static Line Element. R. C. Tolman. *Nat. Acad. Sci., Proc.* 16. *pp.* 511-521, *July*, 1930.—The geometry of a universe in which the line element is given by

$$ds^2 = -e^{(g)}[(dx^2 + dy^2 + dz^2)/(1 + r^2/4R^2)] + dt^2,$$

in which $r = \sqrt{x^2 + y^2 + z^2}$ and R is a constant, is discussed analytically. Relations between the distance r to a given nebula, and the actual observations of angular extension and luminosity, are derived. These relations differ from what would be expected in the case of stationary objects in flat space-time, and the difference appears to be just within the existing range of possible observational detection. J. S. G. T.

89. Distances and Radial Velocities of Extra-Galactic Nebulæ, and Explanation of the Latter by Relativity Theory of Inertia. W. de Sitter. *Nat. Acad. Sci., Proc.* 16. *pp.* 474-488, *July*, 1930.—This investigation is based on the data given by Hubble [see Abstract 1683 (1927)] concerning spiral, elliptical and irregular nebulæ. Formulæ are found to express the correlation between their distance and apparent diameter, and their distance and apparent total magnitude, using distances determined by Hubble, Lundmark and Shapley, from Cepheids, Novæ, and the brightest stars. Comparing the distances with observed radial velocities, it is clear that they are proportional to one another. There are, as is well known, only two possible statical solutions of the field equations of the general theory of relativity, and it is shown that one is negatived by the observed systematic motions of the extra-galactic nebulæ, and the other by the density of these nebulæ in space. Both statical solutions must therefore be rejected, and the dynamical solution proposed by Lemaître, though not yet the last word, represents an important step towards the true interpretation of nature. In this the universe is homogeneously filled with matter, and has spherical symmetry throughout its history, its radius increasing from an initial value of zero to infinity: the initial stage corresponds with Einstein's solution, but this is unstable, and the necessary change is taken to be an expansion, in accordance with the observed positive radial velocities of nebulæ. The date of the initial stage may be a finite or an infinite time ago. The constant λ, which is a measure of the inherent expanding force of the universe, is still very mysterious, but perhaps we may hope that it will ultimately be found to be in some way connected with Planck's constant h. M. A. E.

LIGHT.

90. Automatic Device for the Study of the Ultra-Violet Absorption of Liquids. A. Andant. *Rev. d'Optique*. 9. *pp.* 316–322, *Aug.*, 1930.—Describes a simple device which does not require important modifications of the spectrograph, and allows of a continuous registration of the ultra-violet absorption spectra of a liquid increasing in thickness. A suitable device is also fitted whereby the slit is either open continuously or intermittently, in which case a discontinuous registration occurs. Arrangements are also made for the overlapping of corresponding spectra of different liquids so that easy comparison becomes possible. A study of the absorption of the elements is also possible by arranging a heater round the container and slowly raising the temperature above the corresponding melting point. Further, the variations of absorption which occur during the irradiation of certain materials by ultra-violet light can also be examined. Finally, a method is suggested whereby the coefficient of absorption may be measured by photographic photometry methods.
R. C. F.

91. Absorption of Ultra-Violet Light by Some Organic Substances. (Miss) B. Charlampowiczówna and L. Marchlewski. *Acad. Polonaise Sci. et. Lettres, Bull.* 6*a*–7*a*. *pp.* 376–398. *June-July*, 1930. *In English.*—Hilger's sector method has been used in these investigations, the source of light being sparks produced between Jones or steel-wolfram electrodes. Data are given for the following substances: 1 : 6- and 2 : 6-dimethyl naphthalenes, the ethyl ethers of α- and β-naphthol, indene, thionaphthene, *o*-biphenol, *o*-hydroxy diphenyl, dicyclopentadiene, isoquinoline, acridine, carbazole, biphenylene-oxide, fluorene, phloridzin, amygdalin, salicin and arbutin.
H. H. Ho.

92. Coloration of Crystals of Alkali Halides by Ultra-Violet Light. A. Smakula. *Zeits. f. Physik*. 63. 11–12. *pp.* 762–770, 1930.—The author has determined the absolute values of the absorption constant, on the long wave-length side of the first ultra-violet absorption band, for crystals of RbCl, RbBr, KBr and KI at room-temperature, and of KBr at -183° C. He also gives the absorption spectra of the foreign coloration of the first kind for LiF, RbBr and KI. He has measured the number of coloration centres formed, and the number of absorbed light quanta, and comes to the conclusion that in the first ultra-violet absorption band the absorption of each quantum separates a single coloration centre, a neutral alkali metal atom in some loose connection with the lattice. A limit is, however, set to the number of these centres owing to reversion to the original state, the limit depending on the individual properties of the crystal (temperature, number of foreign ions and other faults in the lattice).
H. N. A.

93. Temperature Dependence of Absorption of Glasses in the Ultra-Violet. W. Weizel and H. W. Wolff. *Zeits. f. techn. Physik*, 11. 9. *pp.* 358–361, 1930.—The continuous absorptions of "Supremax," "Suprax" and "Gundelach" glasses are investigated photometrically over the range 3800–3150 Å. at various temperatures, and are found to

spread towards the longer wave-lengths with increase of temperature. A numerical example is given to show the effect of this in the use of glass absorption tubes for general optical absorption work. C. B. A.

94. Definition of the Ideal Radiation Filter. F. Lauscher. *Gerlands Beitr. z. Geophys.* 27. 1. *pp.* 47–52, 1930.—Briefly discusses Kaempfert's definition of the ideal filter as one which completely transmits the required spectral region and wholly cuts off all of the other parts [see Abstract 560 (1930)]. The ideal filter is considered from photo-electric cell considerations, it being stated that certain filters possess transmission curves unsuitable for caloric measurements, but well suited for use with such cells. It is thus always essential to estimate the ideality of a filter relative to the method and accuracy of the measurements required. R. C. F.

95. Imagery Around a Skew Ray. T. Smith. *Optical Soc., Trans.* 31. 3. *pp.* 131–153; *Disc.*, 154–156, 1929–1930.—The author gives the geometrical definition of conjugate points and generalisations from this and the physical significance of the relation. The conclusions reached are demonstrated with complete generality with the aid of the eikonal. The pencil around any skew ray has 10 degrees of freedom, and the fundamental coefficients which determine the imagery completely are elements of a square matrix of the fourth order. Formulæ are given for the construction of these matrices for refraction at each surface and for the transference from one surface to another. The significance of the matrix elements is explained. For refraction in space of three dimensions a more natural matrix would be of the sixth order and such matrices are derived from those of the fourth order. The coefficients of the eikonal and of the characteristic function are derived from the elements of either type of matrix, and fifteen independent relations between the coefficients of these matrices are obtained in two distinct forms. In the *Discussion*, **T. Y. Baker** suggested illustration of the paper by numerical cases such as are met in practical work and indicates that a failure in approximation is contained in the paper. The author replies. R. S. R.

96. Charts for Simple Two- and Three-Lens Problems. T. Smith. *Optical Soc., Trans.* 31. 3. *pp.* 157–162; *Disc.*, 163, 1929–1930. —A variety of charts can be drawn each of which furnishes complete first order information on systems constructed from two or three thin lenses. Author.

97. Rational Classification of Light-Scattering Media. M. Gurevič. *Phys. Zeits.* 31. *pp.* 753–763, *Aug.* 15, 1930.—In this first paper attention is confined to layers consisting of scattering particles in vacuo or in air. The incident light is taken to be perfectly diffuse, and it is assumed that the light reflected by the layer and the light transmitted by the layer have the same property. The relations between the transmission and reflection factors and the thickness of the layer are shown to be determined by two constants characteristic of the scattering medium, R, the reflection factor for a layer of infinite thickness, and k_1 which is such that the reflection factor for a very thin layer of thickness dx equals $k_1 dx$. Classification of the media is based on the values of R and k_1. Experimental measurements of the transmission factors for different thicknesses of media of the type considered (writing paper, white

cloth, crèpe de chine, etc.) confirm the theory, for a given medium constant values of R and k_1 being obtained. W. S. S.

98. Photodichroism and Photoanisotropy. Part VII. F. Weigert and J. Shidei. *Zeits. f. phys. Chem.* 9. *Abt. B.* 4–5. *pp.* 329–355, *Aug.*, 1930.—Extends the provisional results of Part III [see Abstract 115 (1930)] regarding the influence of the colour of the exciting illumination on the induced photodichroism. Curves connecting the dichroism with the time of excitation were obtained using pure colours, and these were different for each spectral region examined. The authors describe non-sensitised photographic layers as "colour qualified" (*farbentüchtig*), and these react to each spectral colour in a qualitative characteristic manner. A very extensive discussion of the curve-types occasioned by a most peculiar result indicates that they may be caused by the superpositioning of different parts of three principal curve-types in the red, blue and green. This is thus a photochemical analogy to the three-colour mixture principle of the colour sensitivity of the eye. The present knowledge of the photographic latent image should also be extended from a consideration of "colour qualification." [See also Abstract 2789 (1930).] R. C. F.

99. Kerr Effect in Gases and Vapours. Part II. H. A. Stuart. *Zeits. f. Physik*, 63. 7–8. *pp.* 533–557, 1930.—A continuation of previous work [see Abstracts 3314 (1929) and 1406 (1930)] with details of the molecular structure of several aliphatic compounds. J. H. A.

100. Shadow Fringes in the Case of Small Spherical Aberrations. V. Ronchi. *Accad. Lincei, Atti*, 11. *pp.* 998–1004, *May* 30, 1930. *N. Cimento*, 7. *pp.* 348–354, *Nov.*, 1930.—Elaborates the theory given in a former paper [see Abstract 1883 (1928)] and gives instructions for the rapid calculation of spherical aberrations. E. E. F. d'A.

101. Multiplex Interference Spectroscope. E. Lau. *Zeits. f. Physik*, 63. 5–6. *pp.* 313–317, 1930. *From the Reichsanstalt.*—Shows that, when two air or glass etalons are combined to form a multiplex interference spectroscope, the probability of a coincidence of an interference band of the thin plate with one of the thick plate is considerably greater when the ratio between the thicknesses is not a whole number (*e.g.*, is equal to $n \pm 0{\cdot}30$, where n is a whole number) than when the ratio is a whole number. It is thus possible to obtain sharp interferences; and using silvered plates 3 mm. and 9·9 mm. thick, placed about 20 cm. apart in air, a combination has been obtained which gives a resolution greater than that of the thick plate, while the region of dispersion is about three times as great as that of the thin plate. Reproductions of test photographs show the utility of the principle employed. H. N. A.

102. Colourless Compensator for the Interference Refractometer. G. Hansen. *Zeits. f. Instrumentenk.* 50. *pp.* 460–474, *Aug.*, 1930.—The paper gives the results of an investigation of the dispersion properties of different compensating arrangements and the means which exist for the production of a compensator with exact predetermined dispersion properties. The general principles underlying the compensators of Jamin, Lowe, Kosters and Richter are examined, and equations established for the dispersive properties of these one- or two-plate compensators. The conditions for achromatism, the movement of the

zero band and the extension of the natural dispersive region are discussed, and finally the use of Jamin's compensator with four plates (two crown and two flint glass). R. S. R.

103. Improved Quartz Spectrograph. C. Leiss. *Zeits. f. Physik*, 63. 3–4. *pp.* 287–290, 1930.—This spectrograph contains a new arrangement for photographing a wave-length (or wave-number) scale against the spectrum. The disadvantages of the old method of placing an illuminated glass scale in contact with the photographic plate are overcome by projecting the scale on to the plate by a separate lens system. This method has the important advantage that it allows of simultaneous visual observation of spectrum and wave-length scale. C. B. A.

104. Astigmatism in Mirror Spectrometers. M. Czerny and V. Plettig. *Zeits. f. Physik*, 63. 9–10. *pp.* 590–595, 1930.—Continues the investigation of Czerny and Turner [see Abstract 3111 (1930)] and shows that in a mirror spectrometer, with Wadsworth's arrangement, the purity of the spectrum increases, when a change is made from the original incorrect arrangement, to the more satisfactory one now given. The intensity distribution in the images, which in the previous paper was arrived at photographically, has now been measured by a thermoelement. H. N. A.

105. Composite Telescope. E. H. Synge. *Phil. Mag.* 10. *pp.* 353–360, *Aug.*, 1930.—Suggests a form of telescope in which a number of moderately-sized parabolic reflectors perform the functions of a single very large reflector. This is but an extension of Michelson's method of stellar interferometry by the superposition of reflections from small surfaces. Theoretically, such a telescope could be made to give the same degree of resolution as a telescope with a single large reflector. But in temperate regions the minimum diameter of a photographic stellar image is about $0{\cdot}6''$, and even this requires very accurate adjustment. The author first considers the construction of a composite telescope of great light-gathering power. If great resolving power is required, the main difficulty is presented by the disturbed state of the atmosphere in temperate regions. Probably a region could be discovered in which the perpetual west wind at a great height was negligible. In the Antarctic regions some days of perfect calm are occasionally observed. Another advantage is that the weight increases as the square of the aperture and not as the cube. E. E. F. d'A.

106. Mounting of Correcting Lenses in Visual Telescopes. G. W. Moffitt. *J.O.S.A.* 20. *pp.* 457–462, *Aug.*, 1930.—Stellar spectrographs are usually designed for use in the blue and violet regions of the spectrum, since photographic plates are most sensitive in that part, and when the spectrographs are attached to large refracting telescopes designed for visual observation correcting lenses must be added. Small lenses, placed at short distances within the focus of the large objective, have generally been used, but these introduce marked differences of magnification for different wave-lengths, and also have other defects. A lens has been made with a clear diameter of 6 in., and mounted $2\frac{1}{2}$ m. within the focus of the objective of the 40-ft. Yerkes refractor. Details of the mechanism are given, showing how all the difficulties of mounting have been overcome, and a photograph shows the lens in its frame, which is fixed inside the telescope tube, and can be swung out of the light-path

when not required. This replaces a lens of 57 mm., and is found to be very satisfactory. It saves time and labour when instruments at the lower end of the telescope have to be changed, eliminates the need for a minus-blue filter when the camera is on, and as a result of the reduced colour differences of magnification, improved axial definition, and large field of good definition, the effects of flexure in the tube of the telescope have been materially reduced. M. A. E.

107. Sensitiveness of Photographic Dry Plates. M. Miyata. *Kyoto Coll. Eng., Mem.* 6. 2. *pp.* 113–178, *May*, 1930. *In English.*—The nature of the sensitive nuclei in photographic plates has already been explained by Renwick's colloid silver theory and by Sheppard's silver sulphide theory. The present author gives another possible explanation which is the outcome of a very extensive examination. A careful microscopic examination of silver bromide, particularly when precipitated from aqueous solutions, has shown that the bromide is accompanied by the nuclei. From electrometric titration the nature of the nuclei is presumed to be silver chloride, precipitated from a minute trace of soluble chloride impurity in the potassium bromide. Further, it is shown that both silver bromide and iodide act as chemical acceptors, as well as optical sensitisers, for the silver chloride nuclei. The large increase in sensitivity occurring on ripening an emulsion by digestion is explained by the fact that the silver chloride nuclei, separated from the other halides by gelatin occluded during precipitation, again come into contact with the silver bromide or iodide. Thus it is the extreme sensitivity of the silver chloride which gives rise to the sensitivity of bromide plates. R. C. F.

108. Slow-Motion Films. W. Ende. *Zeits. f. techn. Physik*, 11. 10. *pp.* 394–402, 1930.—Discusses the various methods of slow-motion cinematography, particularly the Thun "time-extender" adopted by the A.E.G. in Berlin. This allows the taking of 6000 pictures per second, and works with revolving lenses forming part of the objective or with a slot plate. Gives the method of calculating exposures and of the distortions to be expected, and applies them to the case of an object moving at the rate of 10 m./sec. with a minification of 10 diameters. E. E. F. d'A.

109. Electrical Development of Photographic Layers. E. Fuchs. *Phot. Indust.* 28. *pp.* 927–928, *Aug.* 27, 1930.—The use of electricity in the development of photographic images was first described in 1896 by Banks, but even now development is still chemically performed without any attempt to restore the developer electrolytically. The present author briefly discusses the possibility of such electrolytic recovery either during or after development and describes the results of experiments using chrome-alum as the electrolyte in the developer. It is found that development at the same time as electrolytic recovery produces a large fogging with commercial papers, which could be very much reduced by the addition of a suitable quantity of potassium bromide. With negative layers such as a panchromatic roll film, the fogging was again very pronounced, a great reduction in the latent image also occurring. The fogging may be due to the formation of chromium sulphate by the nascent hydrogen, but this will not account for the latent image reduction. The most probable cause of the two phenomena occurring together is the formation of hydrogen peroxide, and the results of experiments in which

the formation of hydrogen peroxide is aided as well as retarded indicate the correctness of this conclusion for papers. R. C. F.

110. Acid Fixing and Hardening Solutions. J. E. Crabtree and H. A. Hartt. *Kodak-Forschungs Lab. Comm. No.* 396. *Phot. Indust.* 28. *pp.* 928–931, *Aug.* 27, 1930.—Although the use of fixing and hardening baths has increased enormously in the past years, very little is known as to the effects of varying the proportions of their contents on their properties. In the present paper the results of numerous experiments on the properties of such solutions are given, the authors considering the factors which influence the hardening peculiarities of potassium alum baths, the resistance powers of the solutions towards sulphur production and the "developer capacities" of the solutions. Numerous hardness curves are given, and the use of such curves in the estimation of fixing baths with definite properties is discussed. Finally, examples of the use of the curves for the estimation of a fixing bath prescription are given. R. C. F.

111. Improved Form of Photoelectric Density Meter. F. C. Toy. *Journ. Sci. Instruments*, 7. *pp.* 253–256, *Aug.*, 1930.—Details are given of improvements on a photoelectric density meter previously described. With the new apparatus a single observer can measure in a normal day's working about one thousand opacities with values between 1 and 10,000. AUTHOR.

112. Photometry of Rotating Ellipsoid. C. Wirtz. *Zeits. f. Astrophysik*, 1. 3. *pp.* 149–163, 1930.—A continuation of previous work [see Abstract 2147 (1930)] on this subject. Previously the candle-power or, what is equivalent, the average brightness of the ellipsoid was measured. In the work now described the brightness of the illuminated surface has been measured at various points so as to obtain a knowledge of the brightness distribution in each case. As before, the ellipsoids were constructed of matt silver and of chalk. The results, when analysed, show good agreement with values calculated on Lommel's law. For the chalk ellipsoids the agreement with Lambert's law is better than in the case of the silver ellipsoids. J. W. T. W.

113. Antagonism of Radiations in their Effects on a Photographic Plate. Attempt to Classify the Fluorescence of Radium in Wood's Series. E. Wassmer, M. Valladarès and M. Patry. *Helv. Phys. Acta*, 3. 5–6. *pp.* 391–399, 1930. *In French.*—A number of experiments have been made which show that the light (fluorescence) emitted by a glass tube containing radon reverses the effects of daylight on a photographic plate, just as is done by the β and γ-rays of radon and radium contained in a glass tube. The above fluorescence produces effects on the plate which are destroyed by daylight. It does not appear to be possible to classify the fluorescence of radon or of radium in Wood's series. The fluorescence is probably not a simple luminosity. It may be of a corpuscular nature, something like the ordinary δ or secondary radiations, or it may be a phenomenon of the ether. H. N. A.

114. Experiments on Radiothermoluminescence. Frances G. Wick. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 7–8. *pp.* 497–508, 1930.—A synthetic calcium sulphate manganese phosphor and two different fluorites were investigated, and the radiothermoluminescence was measured

photoelectrically. The phosphor had a single green band of luminescence, and when heated showed at a certain time a single maximum of brightness, which was diminished when the substance was subjected to pressure, either before or after it was excited by radium radiation. Fluorite showed a whole series of maxima of brightness during heating, which are to be ascribed to certain sharp bands in the spectra of the rare earths. These maxima are also diminished by pressure, or even totally destroyed; while a faint blue band is intensified by pressure before the excitation with radium. The natural thermoluminescence of the fluorites was also measured; only the more stable maxima appeared, and a high temperature was required. Observations were made of the effect of continued darkness, and of illumination, after excitation and before heating. H. N. A.

115. Absorption and Luminescence of Benzene and Benzene Derivatives at — 259° C. A. Kronenberger. *Zeits. f. Physik*, 63. 7–8. *pp.* 494–532, 1930.—The absorption spectra of benzene, chlorobenzene and *m*-xylene at the temperature of liquid hydrogen are analysed and compared with those of the vapours [see Abstract 1370 (1927)] and the luminescence spectra of several substances are investigated. The following observations are made: (1) The vibration frequencies of benzene and chlorobenzene in the solid and vapour states are the same. The chief difference in the spectra lies in the distribution of intensity. The changes of frequency of the maxima on passing from solid to vapour agree with Raman frequencies. (2) The fluorescence spectrum of benzene at — 180° is the same when excited either by continuous ultra-violet or by mercury light. At — 259° the spectrum is less complete. (3) Characteristic differences between crystalline and amorphous states are found for the super-coolable xylenes. The phosphorescence of the amorphous form is weak and increases with crystal formation. Crystallisation is accompanied by resolution of the wide diffuse bands of the amorphous substance into narrower single bands. (4) The absorption spectra of vapour and amorphous states of *m*-xylene have the same distribution of intensity, while the heads of the bands of these and of the crystalline states fall in the same positions. (5) All the substances investigated show continuous absorption at the short wave-length end of the band spectrum. Only a few weak bands are observed in the region of predissociation. (6) On sudden rise of temperature, the phosphorescence in xylenes cooled to — 259°, shows a brightening blue in colour, of which the absorption spectrum is the same as that of the phosphorescence. The phosphorescence spectra of the xylenes are of the "Vorspektrum" type. There is considerable similarity between the band spectrum of *p*-xylene at — 180° and the Tesla luminescence spectrum of benzaldehyde vapour. Solutions of benzaldehyde in xylenes show that the spectra of benzaldehyde and the xylenes coincide. C. B. A.

116. Chemiluminescence of Antimony-Chlorine Mixtures. S. S. Bhatnagar and K. G. Mathur. *Zeits. f. phys. Chem.* 9. *Abt. B.* 3. *pp.* 229–240, *Aug.*, 1930.—The chemiluminescence of antimony and chlorine reacting alone and mixed with anthracene, mercury, benzol and some phosphorescent sulphides has been studied. The emission spectra have been obtained and the energy necessary to excite the luminescence deduced. In some cases the reaction energy is less than that required to excite the luminescent spectra and an intermediate process is suggested. For instance, the line 2536 brought out by the antimony-chlorine

reaction in mercury vapour is attributed to the catalytic action of water vapour. J. E.

117. Absorption Spectra in Aqueous Solutions of Alkaline Earth Halides. H. Diamond and H. Fromherz. *Zeits. f. phys. Chem.* 9. *Abt. B.* 4-5. *pp.* 289-318, *Aug.*, 1930.—The absorption curves for aqueous solutions of the chlorides, bromides and iodides of Mg, Ca, Sr, Ba, give results similar to those for the halides of the alkali metals. In concentrated solutions of the halides of the alkali and alkaline earth metals, with wave-lengths longer than correspond to the ionic absorption of the iodide, bromide and chloride, no new absorption bands occur to provide evidence for association of ions to form molecules or stoichiometric complexes. The degrees of association which have been determined in various ways for these strong electrolytes probably consist in the formation of complexes under the influence of interionic forces. These non-stoichiometric complexes are formed without any fundamental alteration of the electron shells of the ions concerned, and therefore without any marked effect on the position of the absorption bands in the spectrum; they probably affect the height of bands and the transition probability, which is manifested in alterations in refraction. A. J. M.

118. Absorption of the Silver Ion in the Short-Waved Ultra-Violet. F. Volbert. *Zeits. f. phys. Chem.* 149. *Abt. A.* 5. *pp.* 382-388, *Aug.*, 1930.—Silver perchlorate exhibits two regions of well-marked selective absorption, the first and more feeble maximum being at $\lambda = 2105$, $\log \epsilon = 2 \cdot 95$. The curve then passes through a minimum at 2038 ($\log \epsilon = 2 \cdot 73$) to a second, much more intense maximum at 1930 ($\log \epsilon = 3 \cdot 18$). For the higher concentrations of the perchlorate, Beer's law does not hold for the rising portion of the curve. The invalidity of this law for silver nitrate solutions of concentration 1 and $0 \cdot 1$ mol. is confirmed. With the silver-ammonia complex, the first absorption band of the silver ion disappears, whilst the third is almost completely masked by the absorption of the ammonia itself. T. H. P.

119. Molecular Absorption of Chlorine, Bromine, Iodine Chloride and Iodine Bromide in the Extreme Ultra-Violet. Part I. H. Cordes and H. Sponer. *Zeits. f. Physik*, 63. 5–6. *pp.* 334–344, 1930.—The absorption spectra of the above substances have been investigated from 3000 to 1560 Å. Chlorine and bromine vapours have only continuous absorption, while in the case of iodine chloride and iodine bromide discrete bands are also observable. Certain diffuse bands observed in bromine vapour at low pressures, which are wiped out by the continuous absorption when the pressure is raised, are ascribed to bromine chloride, since it is not possible to obtain bromine free from chlorine, and the frequency difference between the bands does not correspond to that to be expected in the case of the bromine molecule. The bands of ICl and IBr were investigated at different temperatures and pressures. The possible explanations of the different phenomena are discussed; it seems possible that the continuous absorptions starting in the extreme ultra-violet are due to a transference from the potential curve of the ground state to a repulsion curve of an excited state. The ground vibration quantum is about 270 cm.$^{-1}$ in IBr and about 435 cm.$^{-1}$ in BrCl. The energy of dissociation of IBr is given as $1 \cdot 8 \pm 0 \cdot 1$ volt ($41 \cdot 4 \pm 2 \cdot 3$ k. cal.). Attention is called to the bearing of the results on photochemistry. H. N. A.

120. Structure of the Absorption Bands of Tellurium. A. Przeborski. *Zeits. f. Physik.* 63. 3–4. *pp.* 280–286, 1930.—The fine structure of the absorption bands of tellurium vapour, which mostly consists of diatomic molecules, is investigated and the moment of inertia of the diatomic molecules of this element determined. Hitherto such determinations for elements with heavy atoms have been made only for iodine. Two rows of absorption lines are found, one in the region 5393 to 5405 Å. and the other in the region 5357 to 5368 Å., and their convergencies determined. Calculated and observed wave-lengths and wave numbers are given in two tables: one in the first of the regions belonging to a head of wave-length = 5364·7 Å. and of wave-number = 18,640·3 cm.$^{-1}$, and one for the other region belonging to a head of wave-length = 5336·2 Å. and wave number 18,740 cm.$^{-1}$. With an accuracy of 0·2 cm.$^{-1}$, the author finds that the Kessel doublet [see Abstract 189 (1930)] belongs to a head of wave number = 22,946 cm.$^{-1}$. The distance between the two atoms of the Te_2 molecule is calculated. This distance differs little from that for iodine and is nearly equal to the distance found by X-ray analysis between two atoms lying nearest each other in the crystal lattice of tellurium in the solid state. T. B.

121. Vibrational Quantum Analysis of the Potassium Infra-Red Absorption Bands. W. O. Crane and A. Christy. *Phys. Rev.* 36. *pp.* 421–429. *Aug.* 1. 1930.—The heads of the red system of the K_2 molecule have been remeasured, and twenty-six new bands have been found. The vibrational constants derived from our measurements are: $\omega''_e = 92{\cdot}64$ cm.$^{-1}$, $\omega''_e x'' = 0{\cdot}354$ cm.$^{-1}$, $\omega'_e = 74{\cdot}73$ cm.$^{-1}$ and $\omega'_e x' = 0{\cdot}327$ cm.$^{-1}$. The bands of the infra-red system of K_2 λ7735 to λ8850 have been measured and a new vibrational analysis for this system is given, which removes the objections inherent in the analysis of Ritschl and Villars. The constants for this system, as found by us, are: $\omega''_e = 92{\cdot}64$ cm.$^{-1}$, $\omega''_e x'' = 0{\cdot}354$ cm.$^{-1}$, $\omega'_e = 69{\cdot}09$ cm.$^{-1}$ and $\omega'_e x' = 0{\cdot}153$ cm.$^{-1}$. It is shown that the upper state of each of the two systems dissociates into a normal and a ^{2}P excited atom. The energies of dissociation obtained for the upper levels of the two systems agree to within 0·02 volt, the average value being 2·41 volts. From this average value we obtain for the heat of dissociation of the lower level 0·81 volt, while from the formula $(\omega''_e)^2/4\omega''_e x''$ we obtain 0·75 volt. AUTHORS.

122. Spectrum of H_2 Bands Ending on $2p\,^1\Pi$. M. Laura Chalk. *Roy. Soc., Proc.* 128. *pp.* 579–587. *Aug.* 5, 1930.—An extension of Richardson's recent paper [see Abstract 2528 (1930)], describing a new system of bands in the molecular spectrum of hydrogen. The author also deals with some apparent anomalies in the rotational structure of the $2p\,^1\Pi$ levels for the vibrational states corresponding to $v'' = 1$, 2 and 3. Bands were found corresponding to transitions from $3\,^1$A, $3\,^1$C, $3\,^1$K, $3\,^1$O, $4\,^1$A, $4\,^1$B, $4\,^1$C, $4\,^1$E and $4\,^1\bar{X}$ to $2p\,^1\Pi$. Bands were expected for $3\,^1\text{B} \rightarrow 2p\,^1\Pi$ transitions, and have now been identified both for the $0' \rightarrow 0''$ and $1' \rightarrow 1''$ vibration transitions. H. N. A.

123. Arc Spectrum of Palladium. A. G. Shenstone. *Phys. Rev.* 36. *pp.* 669–678. *Aug.* 15. 1930.—A practically complete analysis of PdI is given, based on previous analyses. The electron structures are d^{10}, $d^9 5s$, $6s$, $7s$, $8s$ part of), $d^8 s^2$ (incomplete) $d^9 5p$, $d^8 sp$ and $d^9 6p$ (parts of), $d^9 5d$, $d^9 6d$ (almost complete). The presence of an unidentified level $\bar{s}_1$ is discussed and it is shown that the only explanation within the Hund

theory is that k_1 is a hyperfine structure component of $5d^2P_1$. Such an assignment presents very great difficulties. AUTHOR.

124. Hyperfine Structure of the Arc Spectrum, and the Nuclear Rotation of Indium. D. A. Jackson. *Roy. Soc. Proc.* 128. *pp.* 508–522. *Aug.* 5, 1930.—The object of the investigation was to ascertain if the arc lines of indium showed hyperfine structure due to a quantised nuclear spin producing a magnetic moment of the nucleus. A feature of the experimental method was the use of a reflecting echelon grating of fused silica plates, enclosed in an air-tight box to eliminate disturbance due to temperature variation in the refractive index of the surrounding air. Analysis of the fine structure of the lines $2^2P_{\frac{3}{2}} - 2S_{\frac{1}{2}}$, $2^2P_{\frac{1}{2}} - 2^2S_{\frac{1}{2}}$ and $2^2P_{\frac{3}{2}} - 3^2D_{\frac{3}{2}}$ gave the fine structure energy levels of the S level and the two P levels. The structure of the energy levels is explained quantitatively by ascribing one quantum of rotation to the nucleus, and the magnetic moment of the nucleus is calculated to equal about 5/1840 of that of a spinning electron. This is about five times the result to be expected if the distribution of charge and mass were the same in the nucleus as in the electron. Comparison of the fine structure of the $2^2P_{\frac{3}{2}}$ and the $2^2P_{\frac{1}{2}}$ levels provides an accurate quantitative proof of Fermi's wave-mechanics theory of interaction between electron and nuclear spin. W. S. S.

125. Arc Spectrum of Nitrogen. E. Ekefors. *Zeits. f. Physik.* 63. 7–8. *pp.* 437–443, 1930.—As source a gas discharge tube containing nitrogen and helium was employed, the spectral analysis being effected with a 1-m. vacuum grating spectrograph. To avoid absorption by the wall of the tube, the discharge tube and spectrograph were in connection through the slit, the gaseous mixture circulating throughout the complete apparatus. Some new terms and a displacement of the complete doublet system by 32 frequency units were established. W. S. S.

126. Singlet System of Oxygen Arc Spectrum and Origin of Green Auroral Line. R. Frerichs. *Phys. Rev.* 36. *pp.* 398–409. *Aug.* 1, 1930.—The oxygen arc spectrum has been investigated under varied conditions in the extreme ultra-violet. A number of observed lines have been arranged in the singlet system of terms. The values of the low terms $^1D_2$ and $^1S_0$ have been fixed. AUTHOR.

127. Arc Spectrum of Mercury. F. Paschen. *Ann. d. Physik*, 6. 1 *pp.* 47–49, *Aug.* 6, 1930.—Briefly discusses the results obtained by Takamine and Suga for the mercury arc spectrum of HgI [see Abstract 2816 (1930)]. Further results indicate that the limit of the X-term is 15,294·5 cm.$^{-1}$ and is therefore a $^3P_2$-term. This $^3P_2$-term can also assume two different values. R. C. F.

128. Dispersion of Gases and Vapours and their Interpretation in Terms of the Theory of Dispersion. Part I. Dispersion of Mercury Vapour in the Ultra-Violet. Part II. Dispersion of Mercury Vapour between 7500 and 2650 Å. R. Ladenburg and G. Wolfsohn. *Zeits. f. Physik*, 63. 9–10. *pp.* 616–639, 1930.—Part I. The anomalous dispersion of saturated mercury vapour at definite pressure and temperature is investigated in the neighbourhood of the resonance line 2537 Å. The ratio f of the number of dispersion electrons to the total number of electrons per c.c. is investigated for various pressures

between 0·004 mm. and 200 mm. Between 0·01 and 200 mm. pressure, f is constant and has the value $0·0255 \pm 0·0005$. Below 0·01 mm. the value of f increases slightly. The form of the vapour-pressure curve is discussed. Values of pressure deduced from optical measurements are in close agreement with observed values. The constancy of the value of f between 0·01 and 200 mm. pressure shows that the partial pressure of the molecules themselves can affect the value of the vapour pressure of mercury only by a few per cent. Part II. The dispersion curve of saturated mercury vapour between 7500 and 2650 Å. is in accordance with theoretical anticipation. The curve can be analytically represented by a dispersion equation of the usual type comprising three additive components $\Sigma'_{1,2,3} f_a \lambda_a^2 / (\lambda^2 - \lambda_a^2)$. λ_1 and λ_2 are identified with the absorption lines 2537 Å. and 1850 Å. The value of λ_3 has probably a value intermediate between 1403 and 1190 Å. The anomalous dispersion postulated by Herzfeld and Wolf in the region 6900 Å. is not confirmed. J. S. G. T.

129. Structure of the Mercury Band from $\lambda = 2482·07$ Å. to $\lambda = 2476·06$ Å. (Miss) J. Brzozowska. *Zeits. f. Physik*, 63. 9–10. *pp.* 577–583, 1930.—The bands occurring in the emission spectrum of mercury in the region from 2482 Å. to 2449 Å. have been investigated, using high dispersion. Two new bands with their heads at 2449·5 Å. and 2458·0 Å. have been found, which form a group with bands previously known. The band 2482·07 Å. to 2476·06 Å. has been completely resolved, and the wave-lengths of the separate lines measured. The structure of the band appears to point to the fact that it is the zero branch of a rotation band. The last lines in the band show distinct asymmetry in the distribution of intensity; the reason for this is not clear. H. N. A.

130. Intensity Modifications in the Spectrum of Mercury. S. Tolansky. *Phys. Soc., Proc.* 42. *pp.* 556–562, *Aug.* 15, 1930.—Intensity modifications are noted in the h.f. spectrum of mercury in the region λ7000 to λ2400. All the singlet series are strengthened. In the triplets the first members of the series are weakened by self-absorption. Those inter-combination lines which begin on singlet levels are strengthened, whilst those which begin on triplet levels are weakened. The unclassified lines show three types of behaviour, namely, strengthening, weakening or freedom from change. It is suggested that the strengthened unclassified lines begin on singlet levels, and the weakened on triplet levels, and that the unchanged lines are due to displaced triplet levels in the excited atom. The unclassified lines are thus broadly divided. The degree of intensity modification can be made to vary by alteration of the current density in the discharge tube. Mercury films are produced by the discharge driving mercury into the walls of the tube. These are described and suggestions made as to their nature. The line $6^1P_1 - 8^1S_0$, namely, λ4916, is examined for fine structure with a resolving power of over 3×10^6. It is quite single and very narrow, the half-width being less than 0·004 Å. The intensities of the satellites in λ5461 are found to be altered by self-absorption. Author.

131. Intensity Measurements in the Band Spectrum of Mercury Hydride. Part II. Johanna G. Eymers. *Zeits. f. Physik*, 63. 5–6. *pp.* 396–401, 1930.—The intensity distribution in three further bands of mercury hydride is given [see Abstract 2486 (1929)]. The relation of the total intensities of the bands of a group which have the same commence-

ment level was determined. For a second group with the same oscillation condition but different electron condition in the initial level the same relation is found; another oscillation condition gives quite another result. At the place of the sudden breaking off of the bands the last lines are often widened and very weak. Further results are given regarding these intensities and the widening. J. J. S.

132. Quadripole Radiation in Alkalies. A. F. Stevenson. *Roy. Soc., Proc.* 128. *pp.* 591-599, *Aug.* 5, 1930.—The ratio of intensities of certain lines is calculated from considerations of wave mechanics, and the results compared with observed absorption values. Certain "forbidden" transitions are also considered. F. S.

133. Structure of the Spectra of Doubly and Trebly Ionised Zirconium. C. C. Kiess and R. J. Lang. *Bureau of Standards, J. of Research*, 5. *pp.* 305–324, *Aug.*, 1930.—The spectra emitted by Zr atoms which are doubly and trebly ionised have been observed with the grating and prism spectrographs of the National Bureau of Standards and with the vacuum grating spectrograph of the University of Alberta. These spectra have been analysed and the series relationships involved in them have been established. The terms which have been found to account for the spectra are without exception those required by the quantum theory. Zr IV is a doublet spectrum which results from the migration of a single electron which, in its unexcited state, occupies a 4_3 orbit. From a series of S terms an ionisation potential of 33·83 volts is derived, corresponding to a value of 274,067 cm.$^{-1}$ for the lowest term $4^2D_{\frac{3}{2}}$. Zr III consists of singlet and triplet systems, the terms of which result from the interaction of two electrons occupying 4_3 orbits in their unexcited state. Sequences of ^1D and ^3D terms have been found which result when one of the electrons occupies an n_1 orbit, the other remaining in a 4_3 orbit. These term sequences place the ground term, $^3F_2$, at 194,441 cm.$^{-1}$, which gives 24,000 volts as the ionisation potential of Zr++. Among the Zr III multiplets are those representing the transition $4f \rightarrow 4d$. These multiplets and also those representing intersystem combinations exhibit anomalous intensities. AUTHORS.

134. Transition Probabilities in the First Two Doublets of the Principal Series of Cæsium. R. Minkowski and W. Mühlenbruch. *Zeits. f. Physik*, 63. 3–4. *pp.* 198–209, 1930.—Measurements of the magnetic rotation of the plane of polarisation by saturated cæsium vapour in the absence of other gases, in the neighbourhood of the lines of the doublets, were made at different temperatures. The results gave for the ratio of the lines intensities in the first doublet of the Cs principal series $2{\cdot}1 \pm 0{\cdot}2$, and for the second doublet $4{\cdot}27 \pm 0{\cdot}12$, these values being independent of pressure. The ratio of the total intensity of the first doublet to that of the second equalled 69 ± 10. The measurements also enabled a value to be derived for the heat of evaporation of Cs vapour in the temperature range 455° to 589° absolute, by applying Clapeyron's equation. The value obtained was $(18{,}200 - 2{\cdot}86T)$ cal. Using this result the absolute values of the line intensities were deduced. W. S. S.

135. Effect of Motion of the Nucleus on the Spectra of Li I and Li II. D. S. Hughes and C. Eckart. *Phys. Rev.* 36. *pp.* 694–698, *Aug.* 15, 1930.—The wave equation for a system of N electrons (mass m) and one nucleus (mass M) is set up and solved approximately. If W(m)

are the energy levels for $M = \infty$, the energy levels for finite M are $(\mu W(m)/m) + \Delta W$, where $\mu = mM/(m + M)$ and ΔW is calculable. In case $N = 2$ or 3, ΔW is zero except for P levels. For these it is given by an equation, which is derived on the assumption that the wave function is a polynomial of hydrogen functions, each with its own effective nuclear charge. The values of the latter previously determined by one of the authors are used in comparing the calculation with Schüler's experimental data on Li II, $\lambda 5485$ and Li I, $\lambda 6708$. The agreement is satisfactory and eliminates one objection to Schüler's interpretation of $\lambda 5485$. AUTHORS.

136. Energy-Distribution in the Continuous Spectrum of Hydrogen. Y. Hukumoto. *Tohoku Imp. Univ., Sci. Reports,* 19. *pp.* 301–305, *July,* 1930. *In German.*—A continuation of previous work [see Abstract 1861 (1930)]. The energy distribution in the continuous spectrum of hydrogen is investigated by the method of photographic photometry, in the region $\lambda 4800$ Å. to $\lambda 2900$ Å. Comparison is made using the known energy distribution in the spectrum of the tungsten-filament lamp. The experimental results are in agreement with the theory of Winans and Stueckelberg [see Abstract 1549 (1929)]. A. C. M.

137. Helium Spectrum in the Electric Field. Y. Ishida. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 260. *pp.* 49–61, *Aug.* 3, 1930. *In English.*—The experimental conditions were as formerly [see Abstract 3128 (1930)] except that rectification was made by a kenotron instead of the synchronous motor. By using higher values of electric field, more lines were found than are accounted for by Foster's assignment of quantum numbers [see Abstract 929 (1928)]. The lines are described and the bearing of quantum numbers on the Stark effect discussed. An allied effect, the behaviour of two lines at the point of crossing of the lo Surdo field, is also described. A number of photographs and micro-photometer records are reproduced. F. S.

138. Fine Structure in the Band Spectra of Hydrogen and Helium. S. Imanishi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 264. *pp.* 105–115, *Aug.* 20, 1930. *In English.*—Two high resolution arrangements are described, the one employing a 40-plate transmission echelon crossed with a prism or plane ruled grating, and the other including a 25-plate reflection echelon. A form of liquid-air-cooled discharge is also described. The accuracy of Mulliken and Monk's $\Delta\nu$ values for the $2p^3\Pi$ term of He_2 is increased. The multiple nature, but not the actual separation, of the $2p^3\Sigma$ levels was observed in green Merton bands excited by electrodeless discharge. With a cooled hydrogen tube, red Fulcher bands and Richardson's newly reported $4'A, 4'E \rightarrow 2p'\Pi$ bands were examined for multiplicity. F. S.

139. Fine Structure of Helium as a Test of the Spin Interactions of Two Electrons. G. Breit. *Phys. Rev.* 36. *pp.* 383–396, *Aug.* 1, 1930.—A tentative expression for the quantum Hamiltonian of two electrons has been set up in a previous paper [see Abstract 520 (1930)]. The equation is discussed again. It is shown that the last term in it is subject to doubt. The Hamiltonian is tested by applying it to the calculation of the fine structure of the $He2^3P$ level. It is found that the above-mentioned term in e^4 is in contradiction with experiment. Removing the term from the equation one is left essentially with Heisenberg's old Hamiltonian. The spin interaction in it is shown to agree well with

experiment. The calculation has been applied also to Li^+. The essential improvements on previous work are: (1) an increase in the precision of the unperturbed eigenfunctions; (2) a determination from experimental data of a constant D which depends directly on spin—spin interactions and which can be calculated with fair accuracy. Comparing the theoretical and empirical values of D a clearer test of the magnitude of spin—spin interactions can be obtained than by calculating the relative positions of the three components of the triplet. The reason for this is that the relative positions of the lines depend also on another constant C which is a difference of two approximately equal numbers and is more difficult to calculate accurately. AUTHOR.

140. Electronic States in the Visible Halogen Bands. R. S. Mulliken. *Phys. Rev.* 36. *pp.* 699–704, *Aug.* 15, 1930.—It is shown on the basis of theoretical considerations that the well-known visible iodine absorption bands and the analogous bands of the other halogens almost certainly cannot correspond to a $^1\Sigma \leftarrow {}^1\Sigma$ transition as hitherto supposed. It is concluded that they belong to a $^3\Pi_{0u} \leftarrow {}^1E_g^+$ transition, with a case c $^3\Pi_0$ state whose Λ-type doubling is so wide that the state is split into two separate states which simulate a $^1\Sigma_u^+$ and a $^1\Sigma_u^-$ state. The observed bands involve however only the state which behaves like $^1\Sigma_u^+$, the $^1\Sigma_u^-$-like state and the $^3\Pi_1$ and $^3\Pi_2$ states being unknown. The classification $^3\Pi_0$ really has little meaning, one needs for case c here a classification in which only Ω values and symmetry properties ($+$ or $-$, g or u) are significant. According to the above interpretation, the upper level of the halogen bands is paramagnetic, this is in harmony with certain magnetic phenomena observed with these bands. Electron configurations for the normal and excited states are suggested in the case of fluorine. AUTHOR.

141. Spectrum of Ionised Fluorine (FII). H. Dingle. *Roy. Soc., Proc.* 128. *pp.* 600–624, *Aug.* 5, 1930.—The spectrum from the infra-red to the Schumann region has been obtained by passing suitable discharges through silicon tetrafluoride and 469 lines measured with prism and grating spectrographs. The spectrum is analysed, 173 lines being classified as term-combinations, and the analysis discussed in relation to theoretical expectations. The existence of quintet, triplet, and singlet terms is established, but no intercombinations have been found. Triplet terms from all three states of the F^{++} ion have been evaluated on the same scale, but the singlet and quintet systems are given on an independent scale. An ionisation potential of 34·6 volts for F^+ is deduced. Comparison is made also with the OI spectrum. F. S.

142. β-Bands of Boron Monoxide. A. Elliott. *K. Akad. Amsterdam, Proc.* 33. 6. *pp.* 644–648, 1930.—The $O \rightarrow 1$ and $O \rightarrow 2$ bands of the β-system of BO are analysed and doublet P and R branches are found. The combination differences for the excited state in these two bands agree with each other. It is also found that the normal combination differences for the $O \rightarrow 2$ band agree with those given by Scheib [see Abstract 2540 (1930)] for the $O \rightarrow 2$ band in the α system of BO. A comparison of the β-bands excited in the arc and in active nitrogen shows that, as was suggested by Mulliken [see Abstract 1649 (1925)], it is the R branch which is present in the latter case; the P branch is usually absent. A. C. M.

143. Carriers in Certain Flame Spectra. V. Kondratjew. *Zeits. f. Physik*, 63. 5–6. *pp.* 322–333, 1930.—The CO flame has been

investigated in the region between 5000 Å. and 2800 Å. The bands of this spectrum have been arranged in series with the frequency difference about 600 cm.$^{-1}$. The spectrum is ascribed to the molecule CO_2. The spectra of the "phosphorescence" flames of CS_2 and ether are explained as due in the first case to SO and S_2 molecules, and in the second to H_2CO. H. N. A.

144. Spectra in the Extreme Ultra-Violet. E. Ekefors. *Phys. Zeits.* 31. *pp.* 737–738, *Aug.* 1, 1930.—A preliminary note describing a new vacuum spectrograph for measuring ultra-violet spectra. Photographs of some spectra obtained are given. G. C. McV.

145. Notation for Spectra of Diatomic Molecules. R. S. Mulliken. *Phys. Rev.* 36. *pp.* 611–629, *Aug.* 15, 1930.—In consequence of confusion among workers concerning symbols for quantum numbers, spectroscopic terms, spectrum lines and molecular constants obtained from spectrum analysis, the author has circularised spectroscopists and here summarises the replies received. The most important changes recommended or suggested are:

New.	Old.	New.	Old.
v	n	λ	i_{l_τ}, σ_{l_τ}, σ_{k_τ}
J	j, m, etc.	σ, π, δ, . . .	s, p, d, . . .
M	(magnetic quantum number)	$2p\sigma$, $3s\sigma$ / $3p\pi$, $3d\sigma$, . . .	$2s^p$, $3s^s$ / $3p^p$, $4s^d$, etc.
Λ	i_l, σ_k, σ_l	T; T_e; G	E/hc; E_e/hc; E_γ/hc
Σ	i_s, σ_s, X	Λ-type doubling	σ-type doubling
Ω	i, σ	$^2\Pi \rightarrow {}^2\Sigma$, or $^2\Pi$, $^2\Sigma$, etc.	$^2\Sigma - {}^2\Pi$, etc.
K	p_l, j_k	Σ^+, Σ^-	Σ, Σ'
Σ, Π, Δ	S, P, D . . .	Σ_g, Σ_u, Π_u, Π_g, etc.	—

F. S.

146. Intensities in the Spectra of Diatomic Molecules on Decoupling of the Orbital Electron Impulse. R. de L. Kronig and Y. Fujioka. *Zeits. f. Physik*, 63. 3–4. *pp.* 168–174, 1930.—It can happen in certain light diatomic molecules, *e.g.* H_2, He_2, that, owing to the rapid rotation of the nuclei, decoupling of the orbital impulse of the electrons which is normally quantised with respect to the line joining the nuclei may occur. The present theoretical paper indicates how constants, suitably measuring the decoupling, can be determined, if for a given diatomic molecule the energy values of the rotation levels and their deviations from the normal formula $\{W^0 = A + B(K + \frac{1}{2})^2 - \beta(K + \frac{1}{2})^4\}$ are known experimentally. It is further shown how the results obtained enable the effect of the decoupling on the intensities to be estimated. [See following Abstract.] W. S. S.

147. Intensities in the He_2 Bands on Decoupling of the Orbital Electron Impulse. Y. Fujioka. *Zeits. f. Physik*, 63. 3–4. *pp.* 175–187, 1930.—Quantitative measurements of the intensities for a series of bands in the singlet and triplet system of He_2 are reported. The method of computing the intensities, described in the theoretical paper [see preceding

Abstract], is applied to the results, and the calculated value compared with the observed. Satisfactory agreement is obtained. W. S. S.

148. Band Spectra Intensities for Symmetrical Diatomic Molecules. E. Hutchisson. *Phys. Rev.* 36. *pp.* 410–429, *Aug.* 1, 1930.—On the basis of wave mechanics, the intensity of a spectral line is measured by the integral of the product of the electric moment and the wave functions of the initial and final states. It is possible to carry this integration through approximately for vibration electronic transitions in symmetrical diatomic molecules, and a formula is developed for the intensity of any band in the electronic vibration spectra of these molecules. In the case of certain bands of Na_2, K_2, I_2 and H_2, good agreement with experiment is obtained. F. S.

149. Intensity Measurements in the Spectrum of Nickel and Cobalt. L. S. Ornstein and T. Bouma. *Phys. Rev.* 36. *pp.* 679–693, *Aug.* 15, 1930.—Quantitative intensity measurements have been carried out in the NiI and NiII, and the CoI spectrum. The spectrographic outfit for the intensity measurements consisted of a stigmatic concave grating mounting used with step weakeners, and a Hilger E1 used with the method of slit width variation. The summation rules have been tested both for multiplets and supermultiplets, also the intensity ratio for singlets and triplets, doublets and quartets. Serious divergencies have been found everywhere. In the NiII spectrum an extension of the summation rules to supermultiplets gives better results in several cases. Intensity tables are given of the lines measured. Authors.

150. Intensities of the Balmer Lines as Function of the Conditions of Excitation. L. S. Ornstein and H. Lindeman. *Zeits. f. Physik*, 63. 1-2. *pp.* 8-19, 1930.—The intensities of the Balmer lines emitted by a Geissler tube with varying strengths of current and pressures were investigated and conclusions are drawn as to the mechanism of the luminosity. It is shown that the emission is brought about only partly through recombination. It is considered whether eventually an "effective temperature" exists with which the electron excitation may be defined. It is shown how the measurements of intensity can lead to a proof of the probabilities of excitation which were calculated by Elsasser by quantum mechanics. J. J. S.

151. Influence of Self-Absorption on Intensity Measurements of Spectral Lines. R. Minkowski. *Zeits. f. Physik*, 63. 3-4. *pp.* 188-197, 1930.—The intensity of emission and the amount of self-absorption increase together. It is usually assumed that measurements of the intensity ratios of spectral lines can readily be carried out at intensities for which self-absorption is negligible. The case of emission from flames is discussed in detail and an upper limit for the intensity employed is deduced such that the error in determining the ratios of two line intensities is less than 1 %. Practical difficulties in the measurement impose a lower limit to the intensity worked with. For the D lines of sodium, the upper limit is computed to be about six times the lower limit. In other cases the available range may be even smaller or non-existent. The following generalisation is arrived at: true intensity ratios of absorption lines can be measured in emission in flames, only if the wave-lengths of the lines exceed 5900 Å. (Bunsen flame) or 5000 Å. (blowpipe flame). The limits move towards longer wave-lengths if the intensity ratio is greater than 2, and towards shorter wave-lengths if it is less than 2. W. S. S.

152. Relation between the Intensities of the Resonance Line and the Intercombination Line of Calcium. W. Bleeker. *Zeits. f. Physik*, 63. 11–12. *pp.* 760–761, 1930.—The ratio between the intensities of the resonance line $1^1S - 2^1P$, 4227 Å., and the intercombination line $1^1S - 2^3P$, 6573 Å., was measured with different current densities and concentrations. A simple carbon arc was employed, the lower rod being hollow and filled with a mixture of $CaCl_2$ and KCl, the proportions of which were varied. It was found that for small concentration of calcium and small current density, when the self absorption of the resonance line was greatly reduced, the intensity ratio tended to 41: 1. H. N. A.

153. Photometry of Spectral Lines. R. v. Hirsch and M. Schön. *Zeits. f. Astrophysik*, 1. 3. *pp.* 164–173, 1930.—Describes an optical system for giving a spectral photograph in which the amount of light reaching the plate decreases linearly from bottom to top of each spectral line. The objective of the spectrograph telescope is stopped with a diaphragm having a square aperture. Midway between the objective and the plate there is placed an opaque diaphragm occupying the lower half of the tube and having its upper edge horizontal and at right angles to the axis of the telescope. In this way the amount of light reaching any part of the plate is inversely proportional to the distance from the bottom of the image. If, now, a photograph of a line spectrum be taken with this system it is clear that, since the exposure is everywhere the same, it is only necessary to measure the distances from the ends of two lines at which the images are of equal density. The intensities of the lines are in inverse ratio to these distances. The effects of various imperfections in the optical system are considered in the paper and an example of the application of the method is included. J. W. T. W.

154. Calculation of the Natural Breadth of Spectral Lines on the Basis of Dirac's Theory. V. Weisskopf and E. Wigner. *Zeits. f. Physik*, 63. 1–2. *pp.* 54–73, 1930.—Dirac's theory of the interaction of matter with radiation and the consequent explanation of the finite breadth of spectral lines are used in the calculation, and the equations are solved by a new approximation method. The solutions remain valid to the same degree of approximation during the whole time concerned in the emission process, and yield the intensity distribution in the emission lines of the atom. The outstanding difference between the result deduced from Dirac's theory and that arrived at classically or by earlier forms of the quantum theory is that the line breadth is determined not only by the life-period of the atom in the initial state, but also by the life-period in the final state. From another standpoint it may be said that in the transformation of an atom from an excited state to the ground state by quantum jumps, there is a statistical relation between the frequencies of the light quanta emitted one after the other in the process. W. S. S.

155. Width of Spectral Lines for Excitation by Collisions of Electrons. U. Mennicke. *Zeits. f. Physik*, 63. 9–10. *pp.* 584–589, 1930.—The investigation was conducted on the resonance line 2537 Å. of mercury vapour, using electrons with velocities produced by voltages up to 600 volts, and current densities up to 5 amp./cm.^{2}; and it was shown that neither of the factors involved influenced the width of the line. This result was made use of in constructing a new primary light source for experiments on resonance radiation. H. N. A.

156. Significance of a Certain Type of Diffuse Band Spectra. H. Kuhn. *Zeits. f. Physik*, 63. 7–8. *pp.* 458–476, 1930.—An explanation is given of a type of diffuse band spectra not arising by predissociation, the theory being an extension of that given by Sommermeyer for the diffuse bands of the alkali halogenides, and resting on an application of the Franck-Condon principle to the case of nearly flat potential curves. The occurrence of long, single series of bands in which the frequency differences far exceed the value of an oscillation quantum, and the origin of a kind of pseudo-convergence are explained. A method is arrived at for constructing quantitatively the potential curve in a limited region near the minimum, and for approximating to the half-value width of the diffuse bands. The approximation agrees well with the experimental values. As examples, the diffuse band series of TlI, AgI, AgBr, Hg_2 and I_2 are discussed. In the case of the Hg_2 molecule it is shown that Mrozowski's extrapolation of the apparent convergence leads to an erroneous value for the heat of dissociation which is inconsistent with other experimental data. W. S. S.

157. Interpretation of Molecular Spectra. Part V. Excited Electron Terms of Molecules with Two Equal Nuclei (H_2, He_2, Li_2, N_2^+, N_2 . . .). F. Hund. *Zeits. f. Physik*, 63. 11–12. *pp.* 719–751, 1930.—Methods previously given [see Abstract 705 (1929)] for explaining and qualitatively predicting molecular spectra are here made more complete, so that the excited electron terms can also be taken into account. The terms which are of the greatest importance for the spectrum are arrived at by replacing the " residue " (*Rest*), corresponding to the deepest states of the molecular ion, by a rotationally symmetrical field of force, and considering the terms resulting from the addition of a photoelectron. The method is discussed for the case of two equal nuclei, and the conceptions of valency combination, and of Mulliken's promoted electron, are explained. Schemes for the electronic terms of H_2, He_2, Li_2, N_2^+ follow with little difficulty, which correspond to those found empirically. Details of the method can be discussed by comparing the theoretical and empirical schemes. In the case of N_2 it is possible at least to arrive at a rough understanding of the empirical spectrum. The paper contains a wealth of diagrammatic information as to the theoretical and empirical terms and bands of the above molecules. H. N. A.

158. Raman Effect. *Indian Journ. Phys.* 5. *pp.* 1–112, *July* 15, *and pp.* 113-236, *Aug* 15, 1930.—A series of papers as follows: " Raman Spectra of Some Elements and Simple Compounds," " Influence of Polymerisation and Molecular Association on the Raman Effect," " Polarisation of the Lines in Raman Spectra," " Raman Effect and Molecular Structure," " Relation of Raman Effect to Crystal Structure and Properties of Diamond," by **S. Bhagavantam**; " Raman Spectra Under High Dispersion," by **W. M. Dabadghas**; " Raman Effect in Crystal Powders of Inorganic Nitrates and Chlorides," " Raman Spectrum and Infra-Red Absorption of Sulphur," " Raman Effect in some Crystalline Inorganic Sulphates: Influence of Paramagnetism on Raman Lines," by **P. Krishnamurti**; " Raman Effect in Diamond," " Raman Spectra of Inorganic Sulphates and Nitrates," by **C. Ramaswamy**; " Intensities of Lines in Raman Spectra," by **S. C. Sirkar**; " Raman Effect in Some Organo-Metallic and Heterocyclic Compounds," " Raman Spectra of the Mercaptans," by **S. Venkateswaran**; " Raman Effect of Some Organic and Inorganic

Substances," by **N. N. Pal** and **P. N. Sengupta**; "Interpretation of Raman Spectra: Some Aliphatic Amines and Alcohols," by **S. Venkateswaran** and **S. Bhagavantam.**

159. Raman Effect and Resonance Radiation. P. Das. *Zeits. f. Physik*, 63. 3–4. *pp.* 224–226, 1930.—Owing to the incident light radiation the thermodynamic equilibrium of a molecular aggregate can be upset, and more molecules in a higher state (say n) be produced. If the normal level be m, and some intermediate level be l, and $m \rightarrow l$, $l \rightarrow n$ be allowed transitions, then the molecules left in the n state by the Raman effect can degrade, with consequent radiation of ν_{nl} and ν_{lm}. The latter is the "resonance-radiation," so that the resonance-radiation can be looked upon as a by-product of the Raman effect. For example, in Wood's sodium vapour experiment the radiation evoked by incident monochromatic radiation is of the type ν_{nl}, ν_{lm}. A. C. M.

160. Operational Wave Equation and the Zeeman Effect. G. Temple. *Roy. Soc., Proc.* 128. *pp.* 487–507, *Aug.* 5, 1930.—The method of employing the Dirac wave equation without specification of the Dirac operators, developed in previous papers, is now extended to the study of the Zeeman effect. Although nothing more is assumed with regard to the structure of the wave operators, it now becomes necessary to correlate them with various physical concepts, because the changes in energy levels produced by a magnetic field depend on microscopic properties, *i.e.* the distribution of current density, in the atom. The derivation of tensors to represent microscopic properties is considered from a general standpoint. The integrated tensors yield the macroscopic properties of the atom (its electric and magnetic moments). The analysis is applied to determine the resolution of an optical doublet in weak or strong magnetic fields, the results agreeing with those obtained by other investigators using more particular methods. An error in the interpretation of the quantum number μ which occurred in the previous paper [see Abstract 3340 (1930)] is here corrected. W. S. S.

161. Attempt to Detect Collisions of Photons. A. L. Hughes and G. E. M. Jauncey. *Phys. Rev.* 36. *pp.* 773–778, *Aug.* 15, 1930.—Assuming that light is corpuscular and that collisions between light corpuscles (*i.e.*, photons) can occur, it is shown that two photons of identical frequency ν, moving along paths which make an angle 2θ with each other, will on collision give rise to a photon of frequency $\nu(1 + \cos\theta)$ travelling forward along the line bisecting the angle. To test this, two beams of sunlight (one suitably deflected by a mirror), filtered through red glass, were passed through lenses 24 cm. in diameter and of 33 cm. focal length, so that the beams, whose axes made an angle of 120° with each other, intersected at a common focus. The point of intersection of the beams was examined through a green filter with the dark-adapted eye. No light was detected. Calculations show that if the photon has a cross-section, its area must be less than 3×10^{-20} cm.^{2}. From a result of Lord Rayleigh, some writers have suggested an area of the order of λ^2 for the photon. Our result shows the area to be of the order of $10^{-10}\lambda^2$. AUTHORS.

162. X-Ray Intensimeter. K. Adati and K. Miyaki. *Electrot. Laborat. Tokyo, Japan, Circ. No.* 70. [13 *pp.*], 1930.—This paper describes some results on the measurement of X-ray intensities by the galvanometer method. AUTHORS.

163. Absorption of X-Rays by Lithium. K. C. Mazumder. *Phys. Rev.* 36. *pp.* 457–459, *Aug.* 1, 1930.—The mass scattering coefficient of lithium has been measured between the wave-lengths 0·587 — 0·100 Å. The results for the long wave-lengths can be expressed by the equation $\mu/\rho = 0 \cdot 94\lambda^3 + 0 \cdot 162$. A very rapid bending of the curve towards the axis λ^3 is noticed below the wave-length 0·2 Å. [See also Abstract 707 1927).] AUTHOR.

164. Influence of Absorption in the Debye-Scherrer Arrangement. A. A. Rusterholz. *Zeits. f. Physik*, 63. 1–2. *pp.* 1–7, 1930.—With regard to the influence of absorption on the intensities of the X-ray interference lines of Debye-Scherrer diagrams by use of rods of circular cross-section integrals are met with which must be evaluated either graphically or numerically, involving tedious processes. It is the object of this paper to show that in the case of great absorption these integrals can be strictly calculated by shortened methods. J. J. S.

165. Width and Intensity of Debye Lines or Rings in Relation to Tube-Focus, Camera, and Specimen Dimensions. W. Busse. *Zeits. f. Physik*, 63. 3–4. *pp.* 227–244; 66. 3–4. *pp.* 285–288, 1930.—An attempt to develop an exact geometrical optics of the Debye method, in which general results obtained by Möller and Reiss by graphical methods [see Abstract 3342 (1929)] are investigated mathematically. Some approximations, and restrictions to particular cases, are, however, still necessary. The width of a Debye line and the intensity in it are calculated from the dimensions of the X-ray source, the camera, and the prepared specimen, and from this the most favourable dimensions for specimen and focus to give the maximum obtainable intensities are deduced. C. B. A.

166. Reflection of X-Rays from Zinc Blende. D. Coster, K. S. Knol and J. A. Prins. *Zeits. f. Physik*, 63. 5–6. *pp.* 345–369, 1930.—When two lines on two sides of the zinc K-edge are compared, a measurable difference in the intensity for reflections at the two different III surfaces of the zinc blende can be expected. This difference corresponds with the polar character of the ZnS and is due to the fact that the phase difference between primary waves and scattered waves for scattering at Zn is different from that for scattering at S. The ZnS crystal may be considered as composed of double layers in the III direction consisting of a Zn mesh surface and an S mesh surface at a distance of a quarter of the grid constant. In a natural crystal surface the bright well-developed III face has the S atoms of the double layer on the outside, while the dull, less well-developed face has the Zn atoms outside. Piezoelectric observations show that with pressure perpendicular to the III face the bright face (S outside) is positive. It is necessary, as numerical results show, to assume that not only the amplitude but also the phase of the X waves scattered by atoms is a function of the angle of deflection. The dependence of the phase with scattering at zinc on lines in the neighbourhood of the zinc K-edge is estimated. This estimate is in qualitative agreement with the observed behaviour. J. J. S.

167. Reflection of X-Rays by Absorbing Ideal Crystals. J. A. Prins. *Zeits. f. Physik*, 63. 7–8. *pp.* 477 493, 1930.—The influence of absorption in the Darwin-Ewald (" dynamic ") theory of the reflection of X-rays by ideal crystals is investigated mathematically. A distribution of intensity is found for the image of a spectral line which is asymmetric

about the Bragg angle corrected for refraction in the usual way. The absorption has an appreciable, if not large, influence on the integrated intensity of the line. C. B. A.

168. Quantitative X-Ray Analysis with Secondary Rays. G. v. Hevesy, J. Böhm and A. Faessler. *Zeits. f. Physik*, 63. 1–2. *pp.* 74–105. 1930.—The results of three years' work on the subject are discussed. Except in special cases (liquid specimens, etc.) the secondary radiator was placed inside the tube on the cylinder enclosing the kathode filament, at a distance of 4 or 5 mm. from the antikathode. To obtain high secondary radiator line intensities it is necessary to choose an antikathode material whose characteristic radiation strongly excites the lines to be observed. For lines in the neighbourhood of 1500 X-units, best results were obtained by means of an antikathode material of characteristic radiation of about 150 to 200 X-units on the short wave-side of the line measured. The intensity ratios of lines whose excitation limits did not differ by more than 250 X-units were found to be practically independent of the voltage on the tube. By the correct choice of antikathode material, an exposure time of 2 to 3 hours suffices to determine quantitatively a 1 % constituent of a substance, to an accuracy of $\pm$ 0·01. The following sources of error, which also occur in the primary-ray method, are discussed: foreign substances present with (1) absorption edges between the lines under comparison, (2) with strong emission lines lying between the edges of the lines under comparison, (3) with strong emission lines lying close to the excitation edges of the lines under comparison and on the short-wave side. A table giving about 200 pairs of suitable comparison lines for use in analysis, and a list of cases in which the presence of a third substance might lead to error, conclude the paper. W. S. S.

169. K Absorption Spectra of the Elements Ni, Cu and Zn. A. E. Lindh. *Zeits. f. Physik*, 63. 1–2. *pp.* 106–113. 1930.—Investigations of the fine-structure of the K absorption edges of the pure elements Ni and and Cu showed that in plates showing the fine-structure a double K edge is obtained whose long-wave component corresponds to the single K edge obtained in plates not showing the fine-structure. On investigating the sulphate chloride (Ni and Cu) and sulphide (Ni only), the K absorption edge for the combined element coincided with the short-wave component of the double edge obtained from the pure element. Observations on zinc in the combined and uncombined state also showed a displacement of the K edge (the fine-structure of the edge for the pure element could not be obtained with the dispersion available). The edge displacements involved in the three cases Ni, Cu, Zn, amounted to about $\Delta\lambda = 2·0$, 1·3, and 0·8 X-units respectively. W. S. S.

170. False Lines in X-Ray Grating Spectra. J. M. Cork. *Phys. Rev.* 36. *pp.* 665–668. *Aug.* 15. 1930.—Because of the arrangement of slits, X-ray source and diffraction grating generally employed in X-ray spectroscopy, certain false lines may be obtained on the photographic plate in addition to those due to defects in the grating. Spectrograms of such spurious lines having their origin in a non-uniform focal spot or reflection from slit faces, as well as those due to certain grating imperfections, are shown. One type of companion line is present at wave-lengths about 13 % greater than the parent line, whose origin is not explained. Author.

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171. Isotopes and the Problem of Geologic Time. C. S. Piggot. *Am. Chem. Soc., J.* 52. *pp.* 3161–3164, *Aug.*, 1930.—Geologic time can only be measured by reference to some change, and with changes there are beginning and end conditions as well as a rate. Of the three geologic phenomena which fulfil these conditions throughout great lengths of geologic time only the radioactive disintegration of uranium into lead is relatively simple and most capable of accurate measurements. In uranium minerals, however, some thorium is always present, and this also disintegrates into lead, so that care has to be taken to allow for possible error. It is also difficult to measure the quantity of lead derived from uranium alone, and the author has attempted to measure this experimentally by the identification and determination of the isotopes of lead. Using lead tetramethyl, the three isotopes of lead, 206, 207 and 208, have been shown by Aston to exist in the approximate ratios of 4, 3 and 7. He has also proved their existence in radioactive lead, although the ratios are very different. The existence of isotope 207 indicates that it must have a corresponding source, which is now assumed to be an isotope of uranium. The results are briefly discussed, illustrating the possible sources of the three lead isotopes from uranium isotopes and thorium. R. C. F.

172. Distribution Law in Fractional Crystallisation of Radium Salts. N. Riehl and H. Käding. *Zeits. f. phys. Chem.* 149. *Abt. A.* 3. *pp.* 180–195, *July*, 1930.—The logarithmic distribution formula of Doerner and Hoskins is exactly consistent with the observed distribution of radium between solution and precipitate if the experimental conditions postulated in the theory are fulfilled, *i.e.*, slow crystallisation by evaporation. The Nernst-Berthelot non-logarithmic formula, on the other hand, satisfies the results of Chlopin and of Henderson. The apparent contradiction is explained by the fact that in the latter case, where the salts were crystallised from a super-saturated solution, equilibrium was not established between the solution and the growing crystal surface. Well-formed crystals show no recrystallisation after deposition. A. J. M.

173. Emanating Power of Salts. H. Müller. *Zeits. f. phys. Chem.* 149. *Abt. A.* 4. *pp.* 257–278, *Aug.*, 1930.—Investigation was made of the capacity for emanation of a number of salts with small surface development under various conditions of preservation and previous treatment. From the amount of change of the emanating power under these conditions deductions can be drawn as to the surfaces of the substances examined. Especially a number of water-containing and water-free salts (barium chloride and barium sulphate) were examined as well as amorphous and crystalline silicates (glasses and zeolites) and their capacity for emanation and its change determined. J. J. S.

174. Disintegration of the Lead Atom. Part III. A. Smits and H. S. V. Meinesz. *K. Akad. Amsterdam, Proc.* 33. 7. *pp.* 737–748, 1930. *In German.*—The authors confirm the satisfactory character of their method for rendering lead free from mercury, and again establish the earlier positive results with a quartz lead lamp (see Abstract 1206 (1927)),

but they are not yet convinced that the mercury found has arisen by transmutation. Previous work on an alternative method is discussed [see Abstract 3135 (1928)]. Maracineanu's observation that the lead of the Paris Observatory roof is radioactive and emits α-particles has led the authors to expose lead to radiations of sunlight and also rays of various other frequencies. Full details are given. It was found that the activation of lead as a function of the time of exposure attained a maximum value. The paper is replete with discussion and should be consulted in its entirety. H. H. Ho.

175. Equilibrium Disturbance of Radium B and Radium C in Preparations Freed from Emanation Residues. K. Marbach. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 5–6. *pp*. 231–239, 1930.—The most convenient methods for removing emanation residues have been investigated, *viz.*, washing with alcohol, dilute acids and aqueous caustic potash. The activities of the preparations diminished very much with nitric and hydrochloric acids, and preparations upon metals exhibited disturbance of equilibrium which was absent upon quartz. By washing with alkali there was a strong decline in activity, but no disturbance of equilibrium. Heated in the electric furnace to the vicinity of the melting point, preparations on lead and zinc slightly declined in activity but gave no equilibrium disturbance, whilst no change took place with those on copper at 400° C., although at high temperatures oxidation supervened. No change took place with preparations heated to 555° C. Air blowing produced no change, and emery rubbing only reduced activity. Wiping with a cloth greatly reduced the activities of two preparations on quartz and also caused an appreciable disturbance of the equilibrium. See also paper by Braddick and Cave [see Abstract 859 (1929)], who account for disturbance of equilibrium by the removal of emanation. H. H. Ho.

176. Chemical Behaviour of Polonium. Marietta Blau and Elisabeth Rona. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 5–6. *pp*. 275–279, 1930.—The photographic method of Miss C. Chamié [see Abstract 2508 (1929)] was used for the investigation of some reactions of polonium. Further, it is shown that this method is suitable for proof of cataphoretic migration in the case of electrolysis in various media. J. J. S.

177. Source of the Long-Range α-Rays of ThC. E. Stahel. *Zeits. f. Physik*, 63. 3–4. *pp*. 149–153, 1930.—In a former paper [see Abstract 2575 (1930)] the author showed that the α-rays of great range of the ThC group were not sent out from ThC″. In the present paper a new method is described, and it is shown that the decay product of these long-range α-rays is no normal ThC″, and the conclusion is drawn that these α-rays are sent out from ThC′. J. J. S.

178. Ionisation of Single α- and H-Rays at the End of Their Range. E. A. W. Schmidt and G. Stetter. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 3–4. *pp*. 123–138, 1930.—By means of the valve electrometer which permits the measurement of the ionisation of single corpuscular rays a large number of α- and H-rays with various absorptions were registered. By a special method of estimation the specific ionisation of a separate α- or H-ray was determined. The results are given in curves which indicate that the ratio of the specific ionisation (4 : 1) is, on the whole, maintained up to the end of the range. Moreover, α-rays of small range can be distinguished with certainty from H-rays by measurement

with the valve electrometer, a possibility which is of importance for a great number of atom-disintegration researches. J. J. S.

179. Reflection of α-Rays and Disintegration Effect for Light Elements. E. A. W. Schmidt and G. Stetter. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 3–4. *pp*. 139–150, 1930.—The secondary radiation produced by retarded α-particles from polonium was examined with the valve electrometer for the light elements boron, beryllium, carbon and nitrogen. The measurements were taken with angles in the neighbourhood of 135°, and by comparison experiments with a thin gold leaf for calculation of the theoretical amount of reflected α-particles were referred to the results with this element. For beryllium and nitrogen agreement with the scattering theory was found. For boron and carbon, with α-particles of 3·5 cm. range, there was shown 4 to 4·5 times the theoretical value for secondary α-rays. On the contrary, there was no such deviation with the reflection of α-rays with 2·3 cm. range at carbon. The H-particles due to a disintegration process were determined by a difference method. The results agree qualitatively with those found in earlier researches. For boron, with α-rays of 2·3 cm. range, a disintegration could be clearly observed. J. J. S.

180. Disintegration of Boron by α-Rays from RaC′. H. Fränz. *Zeits. f. Physik*, 63. 5 6. *pp*. 370 380, 1930. *From the Reichsanstalt.*—With the multiplication counter of Geiger and Klemperer in connection with a suitable intensifying valve and an oscillograph an investigation was made of the disintegration of boron by α-rays from RaC′ as well as from polonium by the recoil method. In both cases two clearly separated groups of H-rays were found, of which the longer may indicate a new third group belonging to boron. **Errata,** *ibid*. 64. 11–12. p. 859, 1930. [See also following Abstract.] J. J. S.

181. Disintegration of Boron by α-Rays from Polonium. W. Bothe. *Zeits. f. Physik*, 63. 5–6. *pp*. 381–395, 1930. *From the Reichsanstalt.*—The disintegration of boron was examined by means of the multiplication counter of Geiger and Klemperer. The absorption curves of the atomic disintegration products were found for various directions of emission and for α-rays of various ranges. The third group of H-rays was measured. The two longest groups are in considerable measure homogeneous; their maximum range depends on the direction of emission in so far that it decreases with increasing angle of the α direction whilst the intensity does not change much with the direction of emission. The products in these two groups amount to upwards of 6·5 H-particles for 10^6 α and 0·17 H-particles for 10^6 α respectively, the maximum ranges to 33 and 74 cm. of air with the undiminished α-rays of polonium. With decreasing α range the second group as well as the third decreases more quickly for intensity than for range. If it is assumed that in the disintegration of boron, as in the case of nitrogen, the α-particle of the nucleus is involved and besides that of an H-particle no further portion of the nucleus or γ-rays are sent out, then it must be concluded from the results of the investigation that the energy change in the transformation depends on the direction of emission of the H-particle. J. J. S.

182. Possible Action of Radiations of Short-Wave Length on Atomic Nuclei. G. I. Pokrowski. *Zeits. f. Physik*, 63. 7–8, *pp*. 561–573, 1930.—Gives reasons, based on Aston's measurements of atomic weights, and on Gamow's theory of the equilibrium of the nucleus, for endeavouring to produce disintegration in some of the heavier elements

by acting on them with soft X-rays. These do not commonly exist on the earth, while radiations of longer wave-length are everywhere found in light rays, etc., and of shorter wave-length in cosmic rays, and seem to produce no disintegration. It is suggested that it is possible that the existence of various elements on the earth may be connected with this absence of X-rays. The substances experimented with were exposed to the X-rays for periods up to 48 hours, and then tested with a phosphorescent screen, the scintillations being counted. The results showed a distinct effect for elements heavier than zinc, and from the brightness of the scintillations it was concluded that they were due to α-particles. This activation ceases in general after a few days. The effect produced by γ-rays was also investigated. H. N. A.

183. Passage of Slow β-Particles through Matter—Production of Branches. E. J. Williams. *Roy. Soc., Proc.* 128. *pp.* 459–468, *Aug.* 5, 1930.—The number and energies of the branches (about 150; total length of track about 400 cm.) produced by about 1100 β-particles (photo-electrons produced by homogeneous X-rays reflected from a crystal) in oxygen and nitrogen have been determined, the observations being limited to the initial portions of the tracks, and only branches with energies greater than 3000 volts considered. The frequency of branches calculated according to the classical and the new quantum theories shows that, while the number of short branches is the same according to both theories, for the largest branches the quantum theory gives a number only half that given by the classical theory (atomic electrons being treated as " free " in both cases). As far as they go, the results support the quantum theory, especially as regards the extension of the exclusion principle to aperiodic or open systems. Results in 45 cases where β-particles of energy of about 16,000 volts produced branches of about 4000 volts show that the energy of the β-particles before collision is, within experimental error, equal to the sum of the energies of the branches after collision. There are also indications of action of the nucleus only explicable by the quantum theory. [See Abstract 2414 (1930).] C. A. S.

184. Coloration of Kunzite. K. Przibram. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 1–2. *pp.* 101–104, 1930.—Kunzite rendered colourless by glow treatment regains its rose colour by β-γ-irradiation followed by heating or illumination. There exists therefore the possibility that the natural colour of kunzite has also a radioactive origin. J. J. S.

185. Colouring of Glasses and Some Minerals by β- and γ-Rays. J. Hoffmann. *Akad. Wiss. Wien, Ber.* 139. 2*a*. 5–6. *pp.* 203–230, 1930.—Glasses of the most varied composition were subjected to β- and γ-radiation; some minerals were also treated. The results, together with the chemical composition of the substances and the probable prevailing causes of the radiation colouring, are given in extensive tables. It is concluded that with glasses free of manganese the radiation colours are: yellow, reddish yellow, brown, reddish brown, grey and blackish. As sources of colouring were chiefly neutral atoms of the alkalies, then those of Pb, Ba and Zn. Besides these, the occasional influence of various heavy metal ions must also be assumed. Only with many lead glasses appears a reddish tone in the ground colour; all lead glasses are recognisable by the characteristic fluorescence in ultra-violet light. Various causes are given for the grey or brown to blackish colouring. J. J. S.

186. Wave-Length Measurements of γ-Rays from Radium and its Products. L. T. Steadman. *Phys. Rev.* 36. *pp.* 460–471, *Aug.* 1, 1930.—The wave-lengths of the γ-rays in the spectrum of Ra, RaB, RaC and RaD were determined by the method of crystal diffraction. The rays which experienced diffraction on transmission through a crystal of calcite were received in a Geiger counting chamber which was provided with a slit system that could be turned about a pivot situated at the chamber. By turning the crystal a little so that the diffracted rays were not able to enter the chamber, a method was developed for obtaining the background of the intensity curve and the intensities of the γ-rays, and for investigating the intensity of a possible continuous γ-ray spectrum. Practically all the wave-lengths found by other investigators were obtained and good agreement among all the results was noted. In addition, several other short wave-length γ-rays were found, of which the shortest was 0·42 X.U. Four of them were again determined from measurements made with a diamond which also revealed a γ-ray of wave-length 0·17 X.U. In general, the changes in intensity from one wave-length to another throughout the spectrum corresponded to those given by other workers, but the intensities of the rays were not found to vary as much. A determination of the background of the intensity curve showed that no continuous γ-radiation of any appreciable intensity was present. A more precise measurement made at a wave-length of 53·9 X.U. indicated that a continuous spectrum of γ-rays, if existing at all, raises the background intensity to less than one-tenth the height of the least prominent peaks here found. It has already been concluded from indirect reasoning that the continuous γ-ray spectrum is unimportant. AUTHOR.

187. Scattering of Hard γ-Rays. L. H. Gray. *Roy. Soc., Proc.* 128. *pp.* 361–375, *Aug.* 5, 1930.—A comparison of the scattering power of aluminium and sulphur for hard radium C γ-rays was made. With regard to the energy scattered between 10° and 90° there appeared to be no certain difference in the scattering power, per extra-nuclear electron, of the two elements. Since both scattering and absorption measurements with these rays have failed to distinguish between Al and S, the evidence seems to point to the conclusion that the new absorbing mechanism in Al does not manifest itself until the energy of the quanta is in the neighbourhood of $2{\cdot}5 \times 10^6$ ϵ-volts. J. J. S.

188. Penetrating Radiation. Part III. Annual Variation and Variation with Geographical Latitude. J. Clay. *K. Akad. Amsterdam, Proc.* 33. 7. *pp.* 711–718, 1930.—Observations have been made with two instruments, both protected at the bottom and the sides, so that few rays except those from above could affect them, while in some cases one of the instruments was also screened above. An increase in the intensity of ultra-radiation was observed in May and June, 1929; a similar increase had been observed during the same months in 1927. The number of mobile ions in the atmosphere also increased in both of these periods. Observations were also made with these instruments during voyages from Genoa to Batavia, and from Batavia to Genoa. These show that the intensity does depend on the latitude, but the exact relation is veiled by the fact that the observations were taken at different times in the year. On all three voyages a minimum occurred in the Suez Canal. The difference between Amsterdam and Batavia was about 28 %. [See also Abstract 1898 (1929).] H. N. A.

HEAT.

189. Heat Transfer through Metal-Enclosed Insulation. M. S. van Dusen. *Bureau of Standards, J. of Research*, 5. *pp.* 385–397, *Aug.*, 1930.—The paper gives a mathematical treatment of the problem of heat transfer through an insulated metal-enclosed panel, such as a sheet-metal door, consisting essentially of a sheet-metal box filled with insulating material. The treatment is necessarily approximate, but the approximations involved are accurate enough for practical purposes. The effect of a solid metal thermal short-circuit, such as a supporting member extending from one metal surface to the other, is also considered. Calculations and graphs are included, showing the relative magnitude of the heat transfer by metallic conduction in a number of cases which might be considered in the design of this type of construction. It is shown that the increase in heat transfer through a metal-enclosed panel due to the presence of the metal may be as high as 100 % in many cases, which might be considered in practical designs. AUTHOR.

190. Thermal Insulating Properties of Fabrics. M. C. Marsh. *Phys. Soc., Proc.* 42. *pp.* 570–588, *Aug.* 15, 1930.—One of the chief properties of a fabric is its thermal insulation, which prevents excessive heat loss from the body. The paper gives a critical review of methods used in the past for measuring the thermal insulating properties. These are discussed with a view to the making of a new apparatus for the study of the subject. This apparatus consists of a copper cylinder with guard-ring ends heated electrically to skin temperature. With various fabrics the expenditure of electrical energy necessary to keep it at that temperature is measured. The surrounding conditions are defined by its being enclosed in a larger concentric tube whose temperature is regulated by the circulation of water round it. The humidity of the air can also be regulated. The temperature measurements are all by thermocouple. The weight per unit area and the thickness of the fabrics are measured. There seems to be no definite relation between thermal insulating value and weight, but there is a relation which is very approximately linear between thermal insulating value and thickness. A detailed analysis of the results is being made. AUTHOR.

191. Application of the Hot-Wire Anemometer to the Investigation of Turbulence of an Air Stream. M. Ziegler. *K. Akad. Amsterdam, Proc.* 33. 7. *pp.* 723–736, 1930.—An application of the hot-wire anemometer to the measurement of turbulent flow, based on the fact that when the current heating the wire is varied sinusoidally its temperature changes with frequency in the same manner as its resistance changes with air-speed variations, is described. J. S. G. T.

192. Cooling of Spheres in Currents of Air. J. W. Hughes. *Univ. of Durham Phil. Soc., Proc.* 8. *pp.* 171–190, *July*, 1930.—Solid brass spheres of various diameters up to 1 in. were used, a steady supply of heat being maintained at the centre of the sphere, and surface temperatures recorded by means of nickel resistance thermometers. The air

streams were produced by centrifugal blowers, in a circular wind tunnel of 6 ft. length; the air speed was measured by means of Pitot tubes, with a Chattock manometer. Observations were taken up to 1500 cm. per sec. A correction was made for conduction along the leads, and the supports of the sphere. The results are consistent with the formula $H/\theta = A + B\bar{v}$, where H = heat loss per unit time, θ = mean temperature excess of sphere over air, $\bar{v}$ is the air velocity, whilst A and B are constants depending on the dimensions of the sphere and pipe and on the physical constants of the fluid (in this case air). The temperature of the sphere was measured separately for the upstream and downstream hemispheres, and it was found that the difference was independent of the air velocity, being a function of the total heat supply for any given sphere. J. H. A.

193. Emission of Nickel. W. del Regno. *Accad. Lincei, Atti*, 11. *pp.* 989–993, *May* 30, 1930.—A redetermination of the exponent of T in the Stefan-Boltzmann radiation formula as regards nickel. The value found for a temperature of 300° C. is 4·586. The method adopted was to heat the metal in a water-jacketed enclosure, determine its temperature by thermojunction, and measure its radiation by thermopile. E. E. F. d'A.

194. Radiometer Forces. M. Knudsen. *Ann. d. Physik*, 6. 2. *pp.* 129–185, *Aug.* 16, 1930.—Investigation was made of radiometer forces under the condition that all magnitudes on which the radiometer force could be dependent, and especially the temperatures affecting the problem, were measured. The significance of the accommodation coefficient for the radiometer pressure is indicated, and from the measurements at low pressures it is found that the accommodation coefficient for the internal energy of a diatomic gas in the case investigated can be equated to the accommodation coefficient for the translatory energy. J. J. S.

195. Resonance Radiometer. J. D. Hardy. *Rev. Sci. Instruments*, 1. *pp.* 429–448, *Aug.*, 1930.—A galvanometer system for the measurement of very small voltages, of the order of 10^{-11} volt, is described and its application to the measurement of feeble radiations with a thermocouple discussed. It has been found that energies of the order of 1/200 of that previously detected by other devices can be measured with the resonance radiometer. The effect of the Brownian movement on the system has been calculated and found to be about 1/200 that of the effect on the ordinary galvanometer. An experiment is described for the measurement of the speed of action of thermocouples, and results on the splashed filament type are recorded. Author.

196. Radiation and Temperature in the Visible Spectrum of Colourless Oxides. G. Liebmann. *Zeits. f. Physik*, 63. 5–6. *pp.* 404–436, 1930.—A new method for pyrometric temperature estimation to within 10° is described for bodies emitting radiation of unknown characteristics. The method is compared with earlier-known methods and the theoretical and practical details fully described. The apparatus is used for the investigation of a number of colourless oxides to determine the relationship in the visible spectrum of the emissivity to the temperature, wave-length, and granular size, as also the angle of emission. It is found that the emissivity is strongly dependent on all these factors, and the individual cases are described in detail for various substances and conditions. The limits of error of the several details of the method are also derived and stated. S. G. B.

197. Sources of Error in Thermoelectric Thermometry. O. Walger and F. R. Lorenz. *Zeits. f. techn. Physik*, 11. 7. *pp.* 242–246, 1930.—In addition to the avoidance of stray thermoelectric e.m.f.s at terminals and of trouble due to insulation leakage, considerable care must be exercised in the mechanical and thermal treatment of the thermocouples. Experiments are described showing the effect on the thermoelectric power of copper-constantan, of bending cycles of varying magnitude and of alternate mechanical and thermal cycles. Changes in thermoelectric power may be reduced by prior recrystallisation of the wire by subjecting it to a heat treatment at a temperature outside the range over which the couple is to be used: such conditioned thermocouples are obtainable from Siemens-Halske. The presence of a point of arrest in the working range of the temperature-time curve of either metal is fatal to accurate thermometry. L. V. C.

198. Thermopile for the X-Ray Region to 0·1 Å. O. Gaertner. *Zeits. f. techn. Physik*, 11. 9. *pp.* 363–369, 1930.—After discussing the principles of the Moll thermopile, describes the construction of an instrument suitable for the X-ray region to 0·1 Å. The receiving surface is of platinum-iridium, which possesses the necessary characteristics of high atomic number, high density and electrical resistance, and capability of being worked in very thin sheets. The errors due to electron emission and to radiation scattered from the apparatus are considered. The instrument as constructed had a sensitivity of 1 microvolt for 4 microwatts per sq. cm., when used with a resistance of 32 ohms. With ordinary use, it should have an accuracy of about 3 %, which can be pushed to 0·5 % if elaborate precautions are taken. J. H. A.

199. Behaviour of Clinical Thermometers. H. Ebert. *Zeits. f. Instrumentenk.* 50. *pp.* 397–406, *July*, 1930. *From the Reichsanstalt.*—Two types of errors may enter into the readings of clinical thermometers, *viz.*, (1) continuous errors due to slow secular changes in the glass; (2) discontinuous errors or jumps (*Hüpfen*) due to passage of the mercury through the constriction in small droplets. The first type of error is met most often in the "enclosed scale" type of thermometer, though even here the change in a period of four years does not exceed 0·1° C. The second type of error is commonest with thermometers bearing an engraved stem. Thermometers subject to such errors may be detected and eliminated by proper application of the centrifugal testing method, for which the author works out a theoretical formula, which he successfully puts to experimental test. Thus if a thermometer be heated above 36° C. and placed radially with bulb pointing outwards on the table of a centrifuge, the speed in revs./min., n, required to force the mercury down into the bulb is given by $n = A\sqrt{22 \cdot 5/(R - 5 \cdot 0)}$, where A is a constant (about 385) and R is the radius (cm.) of the path of the bulb. The author compares the values of n required by statute in various countries. A description is given of the examination of thermometers by polarised light to determine the distribution of stresses in the glass. L. V. C.

200. Apparatus for Determining Melting Points. L. M. Dennis and R. S. Shelton. *Am. Chem. Soc., J.* 52. *pp.* 3128–3132, *Aug.*, 1930.—The substance is sprinkled in powder form over the surface of a bar of pure copper electrically heated at one end. A sharp line of division is perceptible between the melted and the unmelted material, and the

temperature on this line is determined thermoelectrically by a constantan point pressed into contact with the copper. The method is recommended for substances melting below 300° C., and particularly for organic substances which decompose on heating, as a complete determination is effected in 30 seconds. L. V. C.

201. Cryostat for Use at Temperatures from 0° C. to −160° C. W. E. MacGillivray and J. C. Swallow. *Journ. Sci. Instruments*, 7. *pp.* 257–259, *Aug.*, 1930.—A cryostat is described in which temperatures between 0° C. and −160° C. can be maintained automatically to 0·01° C. down to −140° C. and to 0·02° C. from −140° C. to −160° C. The cooling is obtained by means of liquid air supplied at an approximately constant rate and the fine regulation carried out with a sensitive hydrogen regulator. The cryostat liquid is pentane. AUTHORS.

202. Examination of the Critical Points of Metals. A. Schulze. *Zeits. f. Metallkunde*, 22. *pp.* 194–197, *June, and pp.* 308–311, *Sept.*, 1930. —The paper describes a number of special experiments in which very pure metals were made use of and treated in a specially designed furnace. The experiments were carried out at the Physikalisch-Technische Reichsanstalt, Berlin, in an endeavour to clear up some of the much debated questions concerning the nature of the changes which take place in solids at their critical points. In this connection the electrical conductivity, thermal expansion of zinc, bismuth, thallium and cobalt in particular, were determined, and the results obtained are recorded in detail. G. K.

203. Coupled Vibrations, with Applications to the Specific Heat and Infra-Red Spectra of Crystals. A. B. Lewis. *Phys. Rev.* 36. *pp.* 568–586, *Aug.* 1, 1930.—The free periods of certain coupled systems of linear oscillators are considered. The complete system discussed consists of p identical coupled groups, each group containing n identical linear oscillators. A solution for the free periods of the system is obtained for the case in which the coupling between the groups is small compared to the internal forces of the groups; certain special cases are noted in which for special values of the forces exact solutions become possible. The behaviour of the pn free periods of a system of pn particles has been studied, when various forces act between the particles, and these are arranged in different ways. The specific heats of four of the normal alcohols have been computed at low temperatures, and compared with the experimental values; a fair degree of agreement has been found, considering the theoretical difficulties. The frequencies of the infra-red spectra of such substances are considered in the theory, but no definite calculations, which can be compared with the experimental results, have been made. H. N. A.

204. Rate of Evaporation of Liquids from a Heated Metal Surface. (Mme.) H. Blaszkowska-Zakrzewska. *Acad. Polonaise Sci. et Lettres, Bull.* 4*a*–5*a*. *pp.* 188–190, *April–May*, 1930. *In English.*—Single drops of various organic liquids were allowed to fall into a conical cavity in a heated block of aluminium-bronze, and the time of complete evaporation studied as a function of the temperature. A maximum rate of evaporation was reached, followed by a sudden fall as the spheroidal state was assumed, at temperatures from 40° C. (acetone) to about 60° C. (nitrobenzene) above the respective boiling-points. [See also following Abstract.] L. V. C.

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205. Rate of Evaporation of Liquids from a Heated Platinum Surface. W. Swietoslawski and S. Bakowski. *Acad. Polonaise Sci. et Lettres, Bull.* 4*a*–5*a*. *pp.* 191–194, *April–May*, 1930. *In English.*—Repeating (Mme.) Blaszkowska-Zakrzewska's work [see preceding Abstract] with a cavity lined with platinum, the authors discover a temperature-range of instability over which a liquid drop (*e.g.*, alcohol-ether mixture) may take only 5 sec. or alternatively as long as 30–35 sec. to evaporate. The lower value corresponds to a maximum rate of evaporation and is constant over a wide range of temperature; the upper tends to fall slowly at higher temperatures. Thus over the range 210°–270° C. the spheroidal state may or may not be assumed, a result (peculiar to platinum) which the authors attribute to surface irregularities. L. V. C.

206. Saturation Vapour Pressure of Lithium. A. Bogros. *Comptes Rendus*, 191. *pp.* 322–324, *Aug.* 18, 1930.—The method described to measure feeble vapour pressures is based on a special case of Knudsen's effusion method where an atomic stream is employed. The apparatus employed was described earlier [see Abstract 3421 (1930)] and the experimental procedure is detailed. In a table are set out pressures for lithium vapour between 510° and 572° A., the error being not greater than 15 %. The time required for the measurements ranged from 1½ to 5 hours. R. S. R.

207. Joule-Thomson Effect in Air. Part II. J. R. Roebuck. *Am. Acad., Proc.* 64. *pp.* 287–334, *Aug.*, 1930.—In a former paper [see Abstract 1069 (1926) the author described apparatus and results of measurements on air at temperatures above that of the room. In the present paper the data are extended to cover the available range below room-temperatures (down to $-150°$ C.). The paper is divided into the following sections: introduction; thermostat bath arrangements; bath refrigeration; plug air supply; thermometers; compressor; barostats; general theory—thermodynamics; experimental results—isenthalps; locus of maxima; Joule-Thomson coefficient, μ; comparison with Hausen; specific heat, C; enthalpy, h; rate of change of heat with pressure, $\mu C = (dQ/dp)_h$; pv data for air; coefficient of volume expansion, α_p; Joule coefficient, η; elastic coefficient, γ; constant pressure air scale; intrinsic energy variation with volume, λ; constant volume air scale; and conclusion. The data are being used to supply part of the material for an article on the liquefaction of air. The next move is to measure the pure gases. The Bureau of Mines is supplying helium as the first pure gas to be measured. T. B.

208. Thermodynamic Treatment of Stationary Conditions in Non-Isothermal Systems. Part II. C. Wagner. *Ann. d. Physik*, 6. 3. *pp.* 370–390, *Aug.* 22, 1930.—A continuation of previous work [see Abstract 1935 (1930)]. Purely theoretical in treatment, as an extension of the former arguments. The thermal transition phenomena, etc., are more closely examined and defined. The variations of the heat effect in the surface layer with alteration of structure due to variation of charge is discussed. A formula is derived for the stationary heat of vaporisation of the electrons during emission from incandescent kathodes. The question of metal-salt junction is investigated and concrete instances (*e.g.*, chlorine ions in solid bleaching powder give negative heat of transition) are considered and the consequences discussed. S. G. B.

SOUND.

209. Acoustics of Large Halls. M. J. O. Strutt. *Zeits. f. angew. Math. u. Mechanik*, 10. *pp.* 360–368, *July–Aug.*, 1930.—Lorentz has shown that the high natural frequencies of a continuous system without friction depend asymptotically on the volume and elastic properties of the system, but not on its shape. Sabine's law states that the period of reverberation of a large hall depends only on the volume and total absorption of the hall. The author shows that Sabine's law is a general asymptotic property of the free and forced vibrations of the continuum if the quotient of the forced frequency by the lowest natural frequency of the system is a large number. Problems are referred to in other parts of physics to which Sabine's law may be applied. G. E. A.

210. Movements of Particles in Kundt's Tube. C. O. Pringle. *Phil. Mag.* 10. *pp.* 139–144, *July*, 1930.—A Kundt's tube was operated by means of a valve oscillator system which gave a note of frequency about 900. The vibrations were communicated to the tube by means of a cork disc, the tube containing silica or cork dust. Numbers of upright discs were formed by the dust near the antinode, the density and completeness of the disc depending on its nearness to the antinode. Certain particles describe straight lines, circles and other orbits. G. E. A.

211. Acoustical Properties of Sound Collectors for Aircraft Sound Locator. J. Obata and Y. Yosida. *Tokyo Univ. Aeronaut. Research Inst., Report No.* 62. *pp.* 231–237, *July*, 1930. *In English.*—The properties of two parabolic reflectors (dia. 2 m., depth 46 and 35 cm.) and two exponential horns (opening dia. 84 and 35 cm., length 300 and 100 cm. respectively) were investigated. The sources of sound were valve generators for the lower frequencies and a dynamic, cone loud-speaker for frequencies above 250. A condenser microphone and string galvanometer were employed in measuring the intensity of the sound. The directive property and magnifying power of the collectors were determined, and for the parabolic reflectors the distribution of intensity along the axis. In the case of the parabolic mirrors the directive properties are excellent, but the magnifying power is not large. A single horn is almost non-directive for low-frequency sounds, and for directional work two horns would be required. The results are exhibited by means of polar graphs for the frequency range 185 to 485. G. E. A.

212. Sound Field Due to a Conical Horn. K. Satô. *Imp. Acad. Tokyo, Proc.* 6. *pp.* 256–259, *July*, 1930. *In English.*—The author has calculated the sound field due to a conical horn with a simple source at its vertex, and here compares the results of the theory with actual measurements [see Abstract 895 (1929)]. Experiments with the source at the vertex of the cone were unsuccessful, and use was made of the reciprocal theorem, the measuring apparatus being placed at the vertex and the position of the source varied. The results verify the correctness of the theory and the applicability of the reciprocal theorem. G. E. A.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

213. Measurements of Contact Potentials of some Metals. Magdalene Forró and E. Patai. *Zeits. f. Physik*, 63. 7–8. *pp.* 444–457, 1930.—The method is that previously described [see Abstract 2256 (1930)] employing a three-electrode valve, the contact difference of potential between the metal of the grid and sodium being determined. The values of this difference for a number of metals are given in the accompanying table (measured values). For comparison the table also includes the values computed from the long-wave limit for photoelectric emission, sodium being assumed to have an exit work of 2 volts. By a modification

Metal	Mo.	W.	Fe.	Ni.	Pt.	Cu.
Measured value	2·0	2·7	1·4	2·45	2·1	2·05
Computed value	2·33	2·52–3·36	1·92–2·3	1·68–2·57	1·63–4·5	2·07–2·63

of the method the contact difference of potential between Hg and Mo was determined and found to equal 0·45 volt, in close agreement with Taube's result for the photoelectric work function of mercury, 4·75 volts. The method can be extended to find the effect of temperature on the contact potential difference. W. S. S.

214. Triboelectricity and Friction. Parts V and VI. Surface Strain and Relaxation of Like and Unlike Solids. P. E. Shaw and R. F. Hanstock. *Roy. Soc., Proc.* 128. *pp.* 474–487, *Aug.* 5, 1930.—It has been shown [see Abstract 1616 (1929)], that charges arise when two identical surfaces are rubbed together. The effects are attributed to progressive strain on the surface, brought about by pressure and friction. In the present papers these effects are standardised by employing definite areas, known forces and stated temperatures. Complete recovery from strain can be attained by rise of temperature. Curves are given showing voltage attained by a given number of rubs between the surfaces. In the experiments described in Part V like materials are used; in Part VI the materials are unlike. In the second case the charges are much larger and change sign with a fewer number of rubs. Experiments in vacuum give results similar to those in open air; the effects are thus claimed to be entirely due to changes in the solid surfaces. The two factors which complicate results obtained in frictional electricity are (1) surface strain; (2) deposition of organic film on the surface derived from fabrics, etc. The authors show that the former may be minimised by carrying strain to the limit, and the latter eliminated by avoiding rubbers such as fabrics. T. B.

215. Deflection and Transverse Vibrations in Piezoelectrically-Excited Quartz Plates. H. Doerffler. *Zeits. f. Physik*, 63. 1–2. *pp.* 30–53, 1930.—With stationary waves in piezoelectrically excited quartz plates the transition from deflection vibrations to transverse vibrations was

observed and a theory is given which explains especially the behaviour of the velocity of propagation of these waves. J. J. S.

216. Micrography of Piezoelectric Quartz. P. T. Kao. *Comptes Rendus*, 191. *pp.* 334–335, *Aug.* 18, 1930.—An account is given of the examination of the positive and negative faces perpendicular to the electric axis of a plate of quartz. The micrographic structures of the two faces are markedly different. Reproductions are given of two microphotographs of the faces showing a magnification of 200 times. The negative face has a fibrous appearance whilst the positive face is distinctly crystalline. The quartz is treated in a somewhat dilute solution of a corrosive substance such as hydrofluoric acid or caustic potash. The characteristic of the negative face is a fibre parallel to the optical axis, whilst the positive face shows a parallelogram having two sides parallel to the optical axis and standing out on a somewhat indefinite crystalline background. J. J. S.

217. Dielectric Constant of Carbon Dioxide as a Function of Temperature and Density. F. G. Keyes and J. G. Kirkwood. *Phys. Rev.* 36. *pp.* 754–761, *Aug.* 15, 1930.—The dielectric constant of carbon dioxide has been measured over a wide range of temperature and density. It has been found that the Clausius-Mosotti function $(\epsilon - 1)V/(\epsilon + 2)$, although independent of temperature, increases slowly with increasing density. AUTHORS.

218. Temperature and Pressure Dependence of the Dielectric Constants of some Organic Vapours. O. Fuchs. *Zeits. f. Physik*, 63. 11–12. *pp.* 824–848, 1930.—H. A. Stuart's apparatus [see Abstract 1706 (1928)] has been used without modification for the measurement of the temperature dependence of the dielectric constants of high boiling-point substances, and systematic experimental errors have been investigated, in particular the disturbing influences due to adsorption layers. The pressure dependence of the dielectric constants at different temperatures has been measured for ether, ethyl chloride and methyl chloride, and the temperature dependence for ether, ethyl and methyl chlorides, and tetramethoxy methane. Using the vapour density data of Stuart and Sänger, the following values have been calculated for the electric moments: $(C_2H_5)_2O$, $\mu = 1{\cdot}14 \times 10^{-18}$; C_2H_5Cl, $2{\cdot}05 \times 10^{-18}$; CH_3Cl, $1{\cdot}86 \times 10^{-18}$. $C(OCH_3)_4$ is less than $0{\cdot}3 \times 10^{-18}$ and probably has no moment at all. Approximate data are given for the infra-red terms. The results are discussed and compared with those of other investigators. H. H. Ho.

219. Dielectric Constants of Regular Crystals. S. Kyropoulos. *Zeits. f. Physik*, 63. 11–12. *pp.* 849–854, 1930.—A procedure for growing regular single crystals by the gradual withdrawal of a cooled platinum tube from a bath of fused salt is described. The method is applied to the preparation of single crystals of LiF, NaF, NaCl, NaBr, KCl, KBr, KI, RbCl, RbBr, RbI, TlCl, TlBr, the dielectric constants of which are then measured by reference to benzene-ethylene chloride mixtures. The results in some cases, particularly the thallium halides, differ considerably from the values obtained when using powders. With certain restrictions the dielectric constants show a simple parallelism with the ionic radii. A. J. M.

220. Dielectric Polarisation of Simple Substances. C. Zakrzewski and D. Doborzyński. *Acad. Polonaise Sci. et Lettres, Bull.* 6*a*–7*a*. *pp.* 300–308, *June–July*, 1930.—From the polarisation data of the elements

hydrogen, helium, argon, neon, nitrogen, oxygen, sulphur, the vapours of mercury and potassium, chlorine, bromine and iodine, it is found that the value of the polarisation is almost exactly the same for the liquid and gaseous states. It is concluded that the restrictions attending the application of the Lorentz formula to the intensity of the interior field in liquids are superfluous in the case of the simple substances above, which are not associated in the liquid state. H. H. Ho.

221. Dielectric Polarisation of Liquid Mixtures and Association. Part I. N. N. Pal. *Phil. Mag.* 10. *pp.* 265–280, *Aug.*, 1930.—The paper describes an investigation, by the heterodyne beat method, of the dielectric polarisation of mixtures of nitrobenzene and benzene and of nitrobenzene and carbon tetrachloride, of various concentrations and at various temperatures. The results are discussed on the basis of Debye's dipole theory and the assumption of molecular associaton. AUTHOR.

222. Dielectric Strength of Degassed Liquids. Lydia Inge and A. Walther. *Zeits. f. techn. Physik*, 11. 9. *pp.* 369–372, 1930.—It is shown that the dielectric strength of degassed xylol is not dependent upon pressure for direct, alternating and impulse voltages. The dependence of the limiting voltage on temperature ceases in the cases of direct and impulse voltages, but for the alternating voltage it gradually decreases with temperature. H. H. Ho.

223. Space Charges and Forces in Insulating Materials. P. Böning. *Zeits. f. techn. Physik*, 11. 9. *pp.* 373–376, 1930.—The space charges and forces occurring in insulating colloidal fluids subjected to an electric field are discussed and investigated experimentally. It is shown that in consequence of the space charges hydrostatic pressure differences are set up in the fluid. Experiments with transformer oil containing colloidal asphalt or colophonium gave results in agreement with the values to be expected from the theory. The results also supply an explanation of the phenomenon of the centrifugal mass displacement in high-voltage cables. [See Abstract 2821 (1929).] A. W.

224. Atmospheric Electric Phenomena and Atmospherics. J. Fuchs and J. Scholz. *Gerlands Beitr. z. Geophys.* 27. 2. *pp.* 175–216, 1930.—Further observations were made at the Sonnblick Observatory on different types of atmospherics. For cold fronts and thunderstorms "clicks" were nor perceptible audibly in the day at distances > 300 km. and at night > 1000 km. No direct relation was found between the "clicks" and simultaneous electric field changes. Simultaneous observations of the sign of the lightning discharge and changes of electric field support the Wilson conception of the positive polarity of thunderstorm clouds. "Grinders" are probably due to irregular glow discharge between adjacent vertical air currents of different temperatures. "Hissing" is a point discharge of audio-frequency with high potential gradient, exceeding 1800 V/m. For this to be visible (St. Elmo's fire) the gradient must be > 5500 V/m. These types and changes of atmospherics can serve to localise and analyse the associated dynamical changes in the troposphere. R. S. R.

225. Electrical Carriers in the Atmosphere during Rainstorms. K. Kähler. *Gerlands Beitr. z. Geophys.* 27. 2. *pp.* 226–240, 1930.—The numbers of atmospherical ions of various kinds, from the small, very mobile ions to the large, slow ions, have been counted at Potsdam Observatory

during light rain, heavy rain, squalls and thunderstorms. The results of these measurements are compared with synchronous records of the atmospheric potential gradient and are discussed in relation to the new Wilson theory as to the origin of the electrical charges on the drops in rain clouds. [See Abstract 280 (1930).] A. W.

226. Electric and Magnetic Field Around an Earth Radiator ("Erdstrahler"). H. v. Ludwiger. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 1. 2. *pp.* 189-226, 1930.—Experiments on the measurement of an elliptically polarised a.c. field around a bipolar system in badly conducting subsoil. Both normal and disturbed fields were investigated. The lines of equal maximum amplitudes for electric and magnetic horizontal components are circles. Electric current spreads in the subsoil as a wave with constant velocity. Small differences of conductivity give no reliable information as to subsoil structure. W. A. R.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

227. Electrical Conductivity of Crystalline Lead Sulphide. G. S. Frey. *Zeits. f. Elektrochem.* 36. *pp.* 511–523, *Aug.*, 1930.—Lead sulphide was prepared in a state of high purity by dissolving pure electrolytic lead in nitric acid and precipitating with hydrogen sulphide. The precipitated lead sulphide was ignited in a current of hydrogen sulphide, and sublimed *in vacuo* at a temperature of about 850° C. The density of the lead sulphide was 7·590 at 20° C. The material was fused and cast into rods, and the conductivity determined by the fall of potential method. The specific resistance of lead sulphide was found to be 0·00306 ohm per cm. cube at 20° C. Between the temperatures of −183° and 100° the specific resistance was found to be $0{\cdot}00258(1 + 0{\cdot}00895t + 0{\cdot}000022t^2)$ within the limits of experimental error. The specific conductivity of lead sulphide was calculated as 388 mhos per cm. cube at 0° C. F. J. B.

228. Tension Coefficient of Resistance of Metals. H. Rolnick. *Phys. Rev.* 36. *pp.* 506–512, *Aug.* 1, 1930.—A new method for measuring the change in resistance of a metal under tension has been developed and applied to fifteen metals. A direct current is sent through the wire under test, while longitudinal vibrations set up in the wire cause the resistance and consequently the potential drop in the wire to fluctuate. These changes are amplified and measured. In this way it has been found that for bismuth, aluminium, manganin, and constantan the resistance decreases with tension, while for all the other metals investigated the resistance increases with tension. Author.

229. Measurements with the Aid of Liquid Helium. Part VIII. Superconductivity of Niobium. W. Meissner and H. Franz. *Zeits. f. Physik*, 63. 7–8. *pp.* 558–560, 1930. *From the Reichsanstalt.*—The superconductivity of niobium containing 1·5 % Sn, 0·05 % Fe and 0·02 % Ta is reported. It sets in at 8·2° to 8·7° K., higher than for any other pure metal yet studied, though not so high as for niobium carbide. The temperatures were measured with a lead resistance thermometer J. H. A.

230. Superconductivity of the Elements. Part II. Fundamental Conception as to the Mode of Origin of Superconduction. Z. A. Epstein. *Zeits. f. Physik*, 63. 9–10. *pp.* 640–659, 1930.—The phenomenon of superconduction and its characteristics, discussed by

the author in a previous paper [see Abstract 3520 (1930)] are here interpreted in terms of the postulation of the existence of solid channels in metals, along which conduction of current takes place. The application of thermokinetic theory then permits the deduction of characteristics which are possessed by superconductors in relatively higher degree than by other metals. A criterion for a superconductor is derived in the form $D.\beta.v^{\frac{5}{3}} \cong$ constant, where D is the directional force, β the atomic compressibility and v the atomic volume. J. S. G. T.

231. Theory of Galvanomagnetic, Thermomagnetic and Thermoelectric Phenomena in Metals. N. H. Frank. *Zeits. f. Physik*, 63. 9–10. *pp.* 596–609, 1930.—Calculates the four transversal galvanomagnetic and thermomagnetic effects for the adiabatic case, using Sommerfeld's theory [see Abstract 1368 (1928)], and investigates the relations between these effects theoretically. The theoretical value obtained for the Hall constant for Ag is $R = 10{\cdot}4 \times 10^{-4}$, and for the constant of the Ettingshausen effect is $P = 0{\cdot}3 \times 10^{-9}$, while the measured values are $R = 8{\cdot}4 \times 10^{-4}$ and $P = 1{\cdot}6 \times 10^{-9}$. The classical formula for R is essentially the same as that derived by the author, while the value for P derived from the classical formula is $36{\cdot}6 \times 10^{-9}$, which is not as near to the experimental value as that obtained by the new theory. The new theory makes the adiabatic value of the Nernst constant Q_a about twice the isothermal value Q_2. Q_a for silver is calculated as $1{\cdot}0 \times 10^{-4}$; the measured value is $1{\cdot}8 \times 10^{-4}$. The classical theory gives $Q_a = 7 \times 10^{-10}$, which does not agree in order of magnitude. Considerable attention is directed to thermoelectric phenomena, and particularly the Thomson effect. It is shown that great care is required in defining the conditions of the problem, and that the Thomson energy consists of two parts, that depending on the alteration of the internal field owing to the heat current, and that due to the alteration of the heat current owing to the electrical current. H. N. A.

232. New Theoretical Magnitudes and Formulæ for Galvanomagnetic and Thermomagnetic Phenomena. A. Perrier. *Helv. Phys. Acta*, 3. 5–6. *pp.* 317–328, 1930. *In French.*—The author, continuing his previous treatment of the subject, introduces certain new definitions, which are more logical than those commonly employed. Let J be the current density observable electromagnetically in a magnetised medium, normal to the magnetisation. This vector is supposed to have two heterogeneous components, one Jex along the potential gradient, given by Ohm's law with a resistance equal to that of the non-magnetised substance, and the other the galvanomagnetic component, which is oblique with regard to J and Jex. The projections of this parallel and normal to J are the effects which are manifested secondarily by the magneto resistance and the Hall effect. This galvanomagnetic component is a special kind of auto-current, which is generated by a substance polarised electrically and magnetically. Gives two views of the elementary polygon of currents, one for bismuth, the other for iron. The relations between the field and the temperature given by the new theory seem much easier to obtain, and more general, than with the old theory. The theory is also extended to thermoelectric and electro-calorific phenomena. [See also following Abstract.] H. N. A.

233. Unitary Interpretation of the Details of Conduction in Ferromagnetic Substances. A. Perrier. *Helv. Phys. Acta*, 3. 5–6.

pp. 400–427, 1930. *In French.*—Deals with conduction of heat and electricity in ferromagnetic materials, making use of the theory introduced by the author in previous papers [see preceding Abstract]. The present paper deals with general hypotheses, phenomena with constant temperature, irreversibilities and reversal of signs, effects of zero field and of intense fields, elementary groups of molecules and real crystals; effects of temperature changes, medium fields, transversal and longitudinal effects, resistivity, region about the Curie point; thermoelectricity; electro-calorific effects, electric currents in conductors at uniform temperature, temperature gradient without resultant electric current, calorific conduction and temperature. The results of the theory are compared with the available experimental data where this is possible, and it is found to explain many of the complex problems of the subject. Some consequences of the theory which have not as yet been observed are mentioned. H. N. A.

234. Loss of Material from the Kathode in Metal Arcs. R. Seeliger and H. Wulfhekel. *Ann. d. Physik*, 6. 1. *pp.* 87–104, *Aug.* 6, 1930.—The loss of material from kathodes of iron, silver and copper in electric arcs in air, nitrogen and neon was experimentally investigated. The dependence of the amount of material lost on (*a*) current density, (*b*) kathode thickness, (*c*) arc length and (*d*) gas pressure are shown in a series of curves. The results are discussed with reference to the theories of v. Hippel, Schmick and Seeliger. A. W.

235. Interpretation of Pressure and High-Velocity Vapour Jets at Kathodes of Vacuum Arcs. K. T. Compton. *Phys. Rev.* 36. *pp.* 706–708, *Aug.* 15, 1930.—Tanberg's conclusions [see Abstract 3525 (1930)] that the evaporating vapour from the kathode of a copper vacuum arc escapes with a temperature of about 500,000° K., which is based upon measurements of the repulsive force against the kathode, is shown to be unnecessary. The observed pressures can reasonably be explained in terms of the " accommodation coefficient " of the incoming Cu ions. It is thus shown that the observed pressures are accounted for if the positive ions retain about 2 % of their incident kinetic energy after neutralisation at the kathode. AUTHOR.

236. Dynamic Characteristics of an Arc Discharge between Tungsten Electrodes in Nitrogen. P. Bächtiger. *Helv. Phys. Acta*, 3. 5–6. *pp.* 335–390, 1930. *In German.*—A d.c. arc discharge between tungsten electrodes was maintained in nitrogen at a pressure of about 400 mm. and on this was superposed a weak a.c. of frequency which was varied from 0·6 to 3600 $\sim$ per sec. The dynamic characteristics of the discharge were obtained with the aid of a kathode-ray oscillograph. The characteristics were also calculated from the theory developed by Wehrli and Hardung [see Abstract 3125 (1929)] and good agreement was found. An account is also given of an investigation of d.c. discharges for very small electrode distances. A. W.

237. Three-Electrode Spark Gaps in Dense Gases. S. Franck. *Zeits. f. techn. Physik*, 11. 9. *pp.* 349–352, 1930.—The question as to the effect of a third electrode, at different potentials, on the discharge potential between two electrodes in a dense gas is discussed and experiments are described which show that the third electrode can be used to control the discharge potential. Most of the experiments were carried out with a point and plane spark gap, the third electrode consisting of a circular ring

concentric with the point and parallel to the plate. The results obtained with the control electrode at various potentials show that the control effect is greatest when a non-homogeneous electric field is, by the presence of the third electrode, made as homogeneous as possible, or *vice versa*. A. W.

238. Glow Discharge. M. Steenbeck. *Zeits. f. techn. Physik*, 11. 9. *pp.* 357–358, 1930.—An effect in the glow discharge attributed by Güntherschulze to thermal causes [see Abstract 2270 (1930)] is here explained by means of the phenomenon previously described by the author [see Abstract 1563 (1930)] of a maximum in the glow-discharge current immediately after the application of the field. A. W.

239. Effect of Long-Wave Spark Radiation on the Photographic Layer. M. Lewitsky. *Phys. Zeits.* 31. *pp.* 769–771, *Aug.* 15, 1930.—Using a spark between molybdenum electrodes with a quartz lens and concave mirror, or with two quartz lenses, images were obtained on old Agfa-Röntgen film previously exposed for a short time to ordinary light. By means of gratings of constants 1 mm. and 2 mm. respectively, it was found that the effective radiations were of wave-length 75–80 μ and 135–140 μ. No appreciable effects were obtained with new Röntgen film, and Eastman Kodak infra-red sensitive plates showed only faint traces. A. W.

240. Absorption of Canal Rays by Solid Bodies. K. P. Jakowlew. *Zeits. f. Physik*, 63. 1–2. *pp.* 114–128, 1930.—The method employed for measuring the intensity of the canal-ray beam was to determine the heating up on absorbing the beam on a battery of thermo-elements. Thin sheets of substances to be investigated (glass, mica, aluminium, platinum) could then be interposed and the absorption coefficient determined. Actually fluctuations in the intensity of the primary beam necessitated the use of a differential method employing two thermopiles. Hydrogen and neon canal rays were employed. The absorbing powers of the substances investigated increased in the order, glass, mica, aluminium, platinum. The exponential law of absorption was not rigorously obeyed, the mean absorption coefficient increasing with the thickness of the absorbing layer. Measurements of the absorption of hydrogen canal rays using different discharge potentials on the tube showed decreased absorption with increased tube potential. Under the same discharge conditions the absorption of neon canal rays was markedly greater than that for hydrogen canal rays. W. S. S.

241. Effect of Illumination on the Reflection of Kathode Rays from Aluminium and Platinum. W. Kohl. *Ann. d. Physik*, 6. 3. *pp.* 391–408, *Aug.* 22, 1930.—An experimental investigation was made of the effect of illumination on the reflection of kathode rays from platinum and aluminium. It was found that it was possible to obtain two kinds of secondary currents, depending on the experimental conditions. It was found that the total radiation may be either greater or smaller than the sum of the components. Both cases have previously been observed. It was also found that in the case considered by Frey [see Abstract 1278 (1929)] reduction of the total current occurred when the foil was subjected simultaneously to electronic radiation and to illumination by ultra-violet light in a homogeneous field, and that this reduction depended only slightly on the velocity of the primary electrons but to a marked degree on the gas content of the foil. With gas-charged foil positive secondary currents may be found in homogeneous fields and these may be explained

by the reduction of the space-charge effect of the absorbed electrons in consequence of the illumination. These secondary currents, under the given experimental conditions, scarcely reached 50 % of the photoelectric current. Greater secondary currents, many times greater than the photoelectric current, can occur with gas-free foils when field variations occur. [See Abstract 2574 (1925).] A. W.

242. Capture of Electrons by Ions. G. Wataghin. *Accad. Lincei, Atti*, 11. *pp.* 993–997, *May* 30, 1930.—Refers to the work of Davis and Barnes [see Abstract 2579 (1930)] and their question regarding the frequency of the light emitted during a recombination. Shows, by a calculation on the basis of wave mechanics, that the probability of recombination is a maximum when the relative velocity of the electron corresponds to a difference of energy levels of a helium atom. E. E. F. d'A.

243. Optical Determination of the Sphere of Action of Atoms for Electrons. L. S. Ornstein and A. M. van Dommelen. *K. Akad. Amsterdam, Proc.* 33. 7. *pp.* 683–689, 1930.—Uses apparatus similar to that employed by Ornstein and Elenbaas [see Abstract 2182 (1930)] in the determination of the sphere of action of He atoms. This method was limited to electronic energies above the excitation potential. It is now shown that it is possible to extend the measurements below that value by using a mixture of helium and mercury. The difference in the new apparatus consists in a side tube containing liquid mercury; this tube and the main discharge tube are heated electrically in such a way that the temperature of the former is always below that of the latter, so that by varying the temperatures the pressure of the mercury vapour in the discharge tube can be varied. A series of photographs was taken of the spectra produced by light from the slit in the cylindrical anode, with a given voltage between the incandescent kathode and the anode, the current being varied. In some cases mercury lines, and in others mercury and helium, were obtained. The resulting values for the active diameters of He and Hg are compared with those of Ramsauer and good agreement is found. H. N. A.

244. Velocity Loss of Slow Electrons in Dense Gases. H. Löhner. *Ann. d. Physik*, 6. 1. *pp.* 50–86, *Aug.* 6, 1930.—Measurements of the critical potentials and estimations of the collision gains were made using the Lenard opposition voltage method as developed by Åkesson. Two types of apparatus with entirely different radiation definitions were used, one in which Åkesson's apparatus was improved, with reference to the geometric definition of the electron stream, by appropriate arrangement of stops, the other a further improvement in that the electron stream was made more homogeneous by electrostatic deviation. Both types of apparatus give pronounced steps in all gas curves measured and these steps are due to critical potentials. Values obtained for the critical potentials of N_2, H_2 and CO_2 agree with those of Åkesson, whilst for argon the values obtained for the critical potentials agree with those previously obtained from electrical and optical methods. The probability of an energy loss without a simultaneous appreciable deviation has been estimated for both types of apparatus, and it is shown that the value of the solid angle involved is a function of the number, arrangement and size of the stops. An estimation of the magnitude of the total collision gain is attempted by eliminating the experimental conditions and making ex-

tremely simple assumptions such as equal angular arrangements of the reflection. [See Abstract 2284 (1930).] R. C. F.

245. Energy Losses and Scattering of Electrons in Mercury Vapour. D. C. Rose. *Canad. J. of Research*, 3. *pp.* 174–185, *Aug.*, 1930.—Experiments have been carried out in which the energy losses of electrons striking mercury atoms have been studied. The apparatus was so designed that scattering relations could be studied for elastic and inelastic collisions. Energy losses representing the 4·7- or 4·9-volt energy level, the 6·7-volt energy level, the 10·4-volt level, or ionisation, and some indication of intermediate levels have been found. Energy losses greater than the ionisation potential have also been found at 11·5 and about 13·5 volts. The latter is without doubt the result of two successive collisions each resulting in the energy loss of 6·7 volts. The former, due to its intensity, cannot be explained as the result of two successive collisions, and its significance is discussed. Similar experiments by Whitney [see Abstract 762 (1930)] and Foard [see Abstract 3534 (1930)] are discussed. The scattering curves are not as accurate as could be wished, due to an insufficient number of observations having been taken. They show, however, that the scattering is not of the type of the inverse square law of force. This is in agreement with observations by Arnot [see Abstract 1584 (1930)]. AUTHOR.

246. Ionisation Potentials of Light Atoms and Ions. W. Braunbek. *Zeits. f. Physik*, 63. 1–2. *pp.* 20–29, 1930.—The regularities are discussed which from the indications of the Moseley diagram of the ionisation potentials of isoelectronic series appear in the first three periods of the periodic system. The regularities are traced back to the behaviour of the screening constants s, and then used to calculate by extrapolation the ionisation potentials of the series He, Li+, Be++, etc., from the value for He assumed as known. [See also following Abstract.] J. J. S.

247. Calculation of the Röntgen K Terms of the Lightest Elements and of the Inert Gases from Optical Ionisation Potentials. W. Braunbek. *Zeits. f. Physik*, 63. 3–4. *pp.* 154 167, 1930.—The Röntgen K terms of some atoms are calculated from the known "optical" ionisation potentials of the series He, Li+, Be++, . . . by subtraction of the "outer screening" of the outer electrons. The outer screening is got approximately with the help of model presentation partly out of further optical ionisation potentials, partly (inert gases) by simple use of the Sommerfeld "inner" screening constants, which are deduced from the relativistic doublet intervals. The calculated K terms agree with the empirical in the case of the lightest elements within small percentages; for the heavier inert gases, after consideration of the relativity correction, the agreement is still more exact. **Errata**, *ibid.* 63. 9–10. p. 718, 1930. [See also preceding Abstract.] J. J. S.

248. Ionisation of Carbon Dioxide by Electron Impact. H. D. Smyth and E. C. G. Stueckelberg. *Phys. Rev.* 36. *pp.* 472–477, *Aug.* 1, 1930.—A new mass spectrograph has been constructed entirely of glass except for the electrodes. Furthermore its design reduces thermal dissociation to a minimum. Using this apparatus the products of ionisation in carbon dioxide have been studied. The primary ions are found to be CO_2^+, CO+, O+ and C+ appearing at 14·4, 20·4, 19·6 and 28·3 volts respectively. There is also some O_2^+ produced as a secondary product

with an ionisation potential of 20·0 volts. Except for CO_2^+ minimum values for all the ionisation potentials can be calculated and are found to agree within the limits of error with the observed values. [See also Abstract 2639 (1930).] AUTHORS.

249. Ionisation of Nitrous Oxide and Nitrogen Dioxide by Electron Impact. E. C. G. Stueckelberg and H. D. Smyth. *Phys. Rev.* 36. *pp.* 478–481, *Aug.* 1, 1930.—The same apparatus used for the study of CO_2 has now been used to study the products of ionisation in NO_2 and N_2O. Thermal dissociation is so serious in NO_2 that the results are somewhat unsatisfactory but NO_2^+, N^+ and O_2^+ are found as primary ions and their appearance potentials determined approximately. In N_2O the results were more satisfactory and the appearance potentials 12·9, 16·3, 15·3, 21·4 were found for the primary ions N_2O^+, O^+, NO^+, N^+ respectively. In both gases other primary ions were probably present but obscured by ions from products of thermal dissociation. As in CO_2 the observed potentials agreed within the limits of error with calculated values. AUTHORS.

250. Application of the Fermi-Thomas Statistical Model to the Calculation of Potential Distributions in Positive Ions. E. B. Baker. *Phys. Rev.* 36. *pp.* 630–647, *Aug.* 15, 1930.—The statistical method of Fermi [see Abstract 2261 (1928)] and Thomas [see Abstract 1276 (1927)] of calculating atomic potential distributions has been extended to include positive ions. A table of potentials for any positive ion is given. The results have been applied to the calculation of (*a*) ionic radii, (*b*) successive ionisation potentials, (*c*) deviations from the Moseley law in optical spectra. AUTHOR.

251. Secondary Emission from Metals by Impact of Metastable Atoms and Positive Ions. W. Uyterhoeven and M. C. Harrington. *Phys. Rev.* 36. *pp.* 709–725, *Aug.* 15, 1930.—Experiments on the secondary electron emission from nickel electrodes due to bombardment of positive ions and metastable atoms in a neon discharge under conditions simulating those at the kathode in a glow discharge are described. Measurements with a collector movable in a direction perpendicular to a fixed plane collector give approximate values of the proportion γ of the apparent positive ion current which is actually carried by secondary electrons. Values of 15–50 % are found depending on the experimental conditions and degree of purity of gas. A perforated plate behind which is situated a Faraday box is used to separate the effects of the ions and metastable atoms. A preponderant part of the emission is ascribable to the metastable atoms, but values of the number α of free electrons per positive ion are found to be 14 to 20 %, varying approximately linearly for ions of velocities of 75 to 150 volts. The secondary electrons originate at the surface of the collector with about 12·5 volts maximum initial velocity. AUTHORS.

252. Effects of Gases on Photoionisation of Cæsium by Line Absorption. F. L. Mohler and C. Boeckner. *Bureau of Standards, J. of Research,* 5. *pp.* 399–410, *Aug.*, 1930.—Relative measurements of the photoionisation by line absorption in cæsium vapour with and without foreign gases were made by the space-charge method. If the effect of a collision with a gas molecule is to change the probability of ionisation from E_o to E_f, then the probability E_p at a gas pressure p is given by $E_o/(E_o - E_p) = E_o(1 + 1/A\sigma^2\tau' p)/(E_o - E_f)$ where A is a known constant,

σ is the distance between atom centres at collision and τ' is the life of the excited state. Nitrogen reduces the ionisation of states 4P to 8P by about the same amounts. $\sigma^2\tau'$ is of the order of 10^{-21} cm.^{2} sec. and $E_f/E_o = 0{\cdot}1$. Hydrogen gives about the same result. Helium increases the ionisation of 4P(E_f/E_o for $4P_1$ is 3) and decreases the effect of other lines to 60 or 70 % at high pressure. $\sigma^2\tau'$ is 10^{-21} for 5P and less for other states. Argon gives very little effect. The effectiveness of nitrogen increases about threefold when the cæsium pressure is changed from 0·012 to 0·002 mm., and the computed change in τ' accounts for this variation. Results indicate a value of σ between 1·4 and 4×10^{-8} for all foreign gases, while the value for the Cs-Cs collision giving ionisation was ten times this. AUTHORS.

253. Photoelectric Properties under Intense Electric Fields. E. O. Lawrence and L. B. Linford. *Phys. Rev.* 36. *pp.* 482–497, *Aug.* 1, 1930.—Shifts of photoelectric thresholds by strong accelerating fields are of interest as involving changes of the work function of a surface without alterations of the other important characteristics of the metal. It is found that the form of the photoelectric sensitivity versus frequency curve changes with the thresholds in intense fields. Thresholds are not sharp, but approach the frequency axis tangentially. Fields as high as 63,000 volts/cm. were used, which shifted photoelectric thresholds towards the red, the shifts being approximately proportional to the square roots of the applied fields. The observations are in excellent agreement with the theory of the photoelectric effect based upon wave mechanics and the Fermi-Dirac distribution of electrons in metals. [See Abstract 3141 (1929).] E. E. F. d'A.

254. Photoelectric Behaviour of Solid and Liquid Mercury. D. Roller. *Phys. Rev.* 36. *pp.* 738–742, *Aug.* 15, 1930.—With monochromatic light, the photoelectric threshold wave-length for solid mercury, freshly distilled and frozen in vacuum, was 2750 ± 25 Å. for all temperatures between — 190° C. and the melting point. For room-temperature it was 2735 ± 10 Å., confirming Kazda'a value. The photoelectric current excited by each of the lines 2537 Å., 2653 Å. and 2700 Å. was independent of temperature between — 190° C. and *ca.* — 125° C. Between *ca.* — 125° C. and — 39° C. there was a gradual small decrease in the current with increasing temperature, but this was not reproducible at definite temperatures and is attributed mostly to contamination and other secondary causes. With the possible exception of this decrease in current, there was no indication of an allotropic change in the mercury between — 190° C. and the melting point. The photoelectric current for the solid phase was always higher than that for the liquid at room-temperature, possibly due to a change in the optical absorptivity of mercury with change in phase. Between — 39° C. and 0° C. the emission curves show so much hysteresis that conclusions regarding this region are impossible. AUTHOR.

255. Photoelectric Cells. (Mrs.) C. Roy-Pochon. *Onde Élec.* 9. *pp.* 366–387, *Aug.*, 1930.—A general treatise on photoelectric cells, the principles of their manufacture, and constructional details of the kathode and anode. E. E. F. d'A.

256. Effect of Photo-Sensitised Mercury Vapour on Walls of Silica Vacuum Tubes. M. C. Johnson. *Phys. Soc., Proc.* 42. *pp.* 490–

500; *Disc.*, 500, *Aug.* 15, 1930.—Investigates some phenomena occurring at the gas-solid interface in certain experiments in which mercury atoms absorb energy from the radiation $\lambda 2537$ and then transfer the energy to other gas molecules at collision. It is shown that a combination of both condensation and liberation of gas at the surface of the apparatus must be taken into account, if the effects of irradiation of a gas mixture are to be traced by any of the usual methods of observing pressure changes. Reference is made to other recent experiments in which atoms in high quantum states communicate their energy to solid surfaces. E. E. F. d'A.

257. Camera for Electron Diffraction. G. P. Thomson and C. G. Fraser. *Roy. Soc., Proc.* 128. *pp.* 641–648, *Aug.* 5, 1930.—An apparatus is described which is called an electron camera, and which is to be used for the study of diffraction patterns formed by the reflection of kathode rays from crystalline surfaces. It differs from the apparatus of Davisson and Germer in that the reflected ray is detected photographically and not electrically, and in that the energy of the electronic beam is much greater. The principle of the apparatus is that a narrow beam of kathode rays generated in a gas-filled discharge tube is selected by passing through two fine pin-holes and then strikes the crystalline target, where it is diffracted into divergent beams which ultimately strike a photographic plate. F. J. W.

258. Analysis of Surface Layers by Electron Diffraction. G. P. Thomson. *Roy. Soc., Proc.* 128. *pp.* 649–661, *Aug.* 5, 1930.—The apparatus described earlier [see Abstract 1165 (1930)] has been used for the investigation of the surface layers of various solids. It appears that the electronic beams used in this camera are so fast that they are not influenced by the layer of adsorbed gas on the surfaces; therefore no special precautions are necessary to keep the surfaces gas free. It is estimated that owing to the small glancing angles employed the electrons penetrate only to a depth of few tens of atoms. Polished and etched metals gave no pattern: gold, iron, lead, aluminium and copper were tried. Similarly electrodeposited copper and gold gave no patterns. It is suggested that the polished metals are covered with an amorphous layer of the type postulated by Beilby. Of the surface layers which gave rings corresponding to a polycrystalline structure, the following examples are given from among those described in the paper. Platinum deposited on zinc or aluminium gave diffraction rings of platinum. When deposited on copper, however, the rings obtained are neither those of platinum or copper. Attention is drawn to the fact that platinum deposited on copper has no catalytic activity. Copper heated gently in air gives the pattern corresponding to cuprous oxide; while copper which has been heated more strongly gives rings which are neither those of cuprous nor cupric oxide. Rusted iron gives diffraction patterns of Fe_2O_3. The layer formed on passive iron appears to be so thin that it is not revealed by this method. F. J. W.

259. Theory of Damped Electrical Oscillations. A. Kneschke. *Ann. d. Physik*, 6. 2. *pp.* 186–194, *Aug.* 16, 1930.—A mathematical investigation of various problems of electric circuits. J. J. S.

260. Resonance and Suppression Effect in Back-Coupled Amplifying Systems. F. Tank and L. Zelwer. *Helv. Phys. Acta*, 3. 5–6. *pp.* 329–334, 1930. *In German.*—Considers back-coupled amplifying

circuits containing capacities and resistances, or inductances and resistances only. It is shown that, as with true oscillatory circuits, such systems can exhibit resonance, when externally excited, or, if self-excited, the suppression effect. [See also Abstract 1305 (1929) and 3840 (1930).] R. C. F.

261. Discussion on Magnetism. *Phys. Soc., Proc.* 42. *pp.* 355–465, *Aug.* 15, 1930.—A series of thirteen papers followed by an open discussion as follows: "Ferromagnetism and Hysteresis," by **A. Ewing**; "Magnetism in the Twentieth Century," by **E. C. Stoner**: "Magnetism and the Quantum Theory," by **H. S. Allen**; "Polarisation of the Electron," by **C. G. Darwin**; "Gyromagnetic Effect and Paramagnetism," by **W. Sucksmith**; "Change in Size of a Ferromagnetic at the Curie Point," by **F. C. Powell**; "Interrelations of Magnetisation and Temperature in Crystals," by **W. Peddie**; "Atomic Moments of Iron, Cobalt and Nickel as Determined from the Magnetic Saturation of the Ferro-Cobalts and Nickel Cobalts," by **P. Weiss** and **R. Forrer**; "A New Relation between Magnetic and Electric Phenomena," by **W. Gerlach**; "Methods of Experimenting in Strong Magnetic Fields," by **P. Kapitza**; "Magnetostriction and Change of Resistance in Single Crystals of Iron and Nickel," by **W. L. Webster**; "Observations on the Specific Heats of Ferromagnetic Substances," by **L. F. Bates**; "Some Relationships among the Ferromagnetic Constants," by **J. R. Ashworth**. *Discussion* by **J. R. Ashworth, L. F. Bates, L. G. Carpenter, S. Evershed, R. H. Fowler, B. W. Holman, H. R. Lang, F. C. Powell, E. C. Stoner, G. Temple and A. M. Tyndall.** A summary of the *Discussion* is also given in *Nature*, 125. pp. 874–875, June 7, 1930, by **A. Ferguson.**

262. Susceptibility of Chrome Alum at Low Temperatures. W. J. de Haas and C. J. Gorter. *K. Akad. Amsterdam, Proc.* 33. 7. *pp.* 676–679, 1930. *Comm. No.* 208*c from the Phys. Lab., Leiden.*—The experimental magneton number of the chromic ion, which is about 19 W.M., shows a greater deviation from the value calculated from Hund's theory (3·9 W.M.) than is found in other salts of the iron group. These, however, do not follow the theory, while those of the rare earths do. The authors have measured the susceptibility of $Cr_2(SO_4)_3 . K_2SO_4 . 24H_2O$ from 14°·33 to 290° K. They find that the Curie-Weiss law is obeyed, with $\theta = 0{\cdot}16°$ C., and $C = 36{\cdot}58 . 10^{-4}$; this makes p, the number of Weiss magnetons, equal to 19·02. The conception of Bose, which assumes that in the chromic ion only the spin vector can freely orientate itself, and which gives the value 18·9 for the magneton number, is supported by this result, while the ideas developed by Sommerfeld and Laporte to explain the magneton numbers in the Fe group are contradicted. H. N. A.

263. Relation of the Susceptibility of Diamagnetic Metals to the Field. W. J. de Haas and P. M. van Alphen. *K. Akad. Amsterdam, Proc.* 33. 7. *pp.* 680–682, 1930. *Comm. No.* 208*d from the Phys. Lab., Leiden.*—A small rod of very pure bismuth was suspended on a balance, in helium gas, between the poles of a magnet, and the forces acting on it were measured by the Faraday method. Measurements were made at 17° C., and at 20·3° and 13·5° K. It was found that the diamagnetic susceptibility of bismuth depends on the intensity of the field, the result being that the Faraday method does not permit of accurate measurements, so that the experiments will have to be repeated with a small crystal, in a region in which $H dH/dx$ is known. Graphs are, however, given, which

show the relation between the force acting on the rod and the magnetic field. At room-temperature the susceptibility remains constant for all fields, while at low temperatures the curves have a form analogous to that of those of Schubnikow and de Haas for the resistance change of bismuth monocrystals in the magnetic field. H. N. A.

264. Magnetic Isotropy of Copper Crystals. C. G. Montgomery. *Phys. Rev.* 36. *pp.* 498–505, *Aug.* 1, 1930.—The variation in the magnetic susceptibility with the direction of the applied field was investigated for large single crystals of copper. A modification of Curie's method of measurement was used. A Fourier analysis of the results indicates that there is no variation of susceptibility larger than 1 %, a result consistent with the magnetic isotropy of cubic crystals predicted by the theory of W. Thomson. AUTHOR.

265. Ferromagnetic Theories of Weiss and Heisenberg. K. Honda. *Zeits. f. Physik*, 63. 1-2. *pp.* 141–148, 1930.—It is concluded from several examples that the above-mentioned theories do not agree with the experimental facts. G. E. A.

266. Magnetisation and Magnetic Ageing of Permanent Magnets for Electrical Instruments. E. Schramkow and B. Janowsky. *Zeits. f. techn. Physik*, 11. 10. *pp.* 429–432, 1930.—The magnetisation of horse-shoe magnets with narrow air-gap may be raised to the saturation value by combining d.c. and a.c. fields. Single-layer coils are wound on the limbs of the magnet, and the armature is put across the ends of the magnet. The whole is then placed inside a cylindrical coil; the limb coils are supplied with d.c. and the outer coil with a.c. The magnet with its coils is then withdrawn from the outer coil, and is thus subjected to an a.c. field which diminishes to zero. Magnetic ageing is then carried out, and the magnet is most stable which has been stabilised in its built-up condition. G. E. A.

267. Parallel Connections of Identical Nets. A. E. Kennelly. *Am. Phil. Soc., Proc.* 69. 4. *pp.* 161–173, 1930.—A mainly mathematical paper discussing the constants of a circuit formed by connecting two equal nets in parallel. The constants of the net may be defined completely in terms of the net angle θ, the geomean surge impedance n_{ab} and the inequality factor q. It is shown that if n identical nets are connected in parallel, the resulting net will have the same $\theta\delta q$, but the surge admittance will be increased to ny_{ab}. [See also Abstract 2761 (1925).] G. E. B.

268. Three-Dimensional Periodic Electron Orbits in the Field of a Non-Neutral Dipole. L. Page. *Phil. Mag.* 10. *pp.* 314–323, *Aug.*, 1930.—The periodic orbits of an electron moving in the field of a stationary electric doublet which has a positive charge associated with it are investigated by the Newtonian dynamics. Special cases of orbits on a cone and orbits on a sphere are treated. The Hamilton-Jacobi method is applied to the problem, the energy being expressed as a function of the phase integrals. The motion is shown to be completely non-degenerate. AUTHOR.

269. Periodic Electron Paths in the Field of an Elementary Magnet and Their Applications. C. Störmer. *Zeits. f. Astrophysik*, 1. 4. *pp.* 237–274, 1930.—The periodic paths of electrons in the field of an elementary magnet (dipole) are found by direct application of the differential equations and by numerical integration. A series of such paths

is calculated and their forms are copiously illustrated. Brüche has succeeded in reproducing a number of these paths experimentally, and has found others which have not yet been subjected to calculation. It is regarded as possible that Eschenhagen's elementary waves, which are registered on magnetograms as small vibrations with periods of several minutes, may be connected with effects due to clouds of corpuscles moving along such periodic paths. G. E. A.

270. Deflection of Electrons by a Magnetic Field According to Wave Mechanics. L. Page. *Phys. Rev.* 36. *pp.* 444–456, *Aug.* 1, 1930.—There is a discrepancy between the values of the ratio between the charge and " rest " mass of an electron, as determined by deflection in a magnetic field, and by the Zeeman effect or H and He spectra. This is four times the probable error, which is due to the fact that the first value is calculated on the classical theory, while the other values depend on the quantum theory. The author has solved the wave equation for a stream of electrons passing through a uniform magnetic field, and discusses the characteristic functions. The motion at right angles to the field is found to be completely quantised. The mean radius of curvature of the path is determined, and found to be less than that predicted by the classical theory; this means that the values of e/μ calculated by means of the classical theory will be too large; the estimated error is of the same order as the discrepancy between the experimental values found by different methods mentioned above. H. N. A.

APPARATUS AND INSTRUMENTS.

271. New Design of Precision Resistance Standard. J. L. Thomas. *Bureau of Standards, J. of Research,* 5. *pp.* 295–304, *Aug.,* 1930.—As a result of investigations of the causes of the slight changes in the resistance of standards of the type developed by Josa, a new type of precision resistance standard has been developed. The coils are wound of bare manganin wire and annealed at a red heat in order to remove the winding strains. They are mounted in double-walled, sealed containers which contain no oil or other cooling liquid. A group of new 1-ohm coils, for which data are given, have been remarkably constant in resistance.

AUTHOR.

272. Sensitive Rotating-Coil Magnetometer. H. R. Nettleton and F. H. Llewellyn. *Phys. Soc., Proc.* 42. *pp.* 501–520, *Aug.* 20, 1930.—This paper describes a sensitive rotating-coil magnetometer in which the flux due to the earth's field or to a magnet is neutralised by that due to a current passing through a fixed concentric compensating coil which forms with the rotating coil a variable mutual inductance. It shows how the first-order correcting term due to the length of the magnet may be made to vanish if the angle of contact be suitably chosen, and that the second-order correction may be eliminated by a correct choice of the dimensions of the coil. Many experiments bearing on the theory and uses of the magnetometer are described. In particular, the ohm may be measured very simply, in terms of a mutual inductance and a period, by Weber's method of damping. AUTHORS.

273. Method of Eliminating the Effects of Magnetic Disturbance in Highly Sensitive Galvanometers. D. S. Perfect. *Phys. Soc., Proc.* 42. *pp.* 532–540, *Aug.* 15, 1930.—The paper describes a method of making correction for the chaotic fluctuations, of magnetic origin, to

which the zero of a highly sensitive moving-magnet galvanometer is susceptible. The method consists in the employment of a second galvanometer with properties adjusted as nearly as possible to identity with, and placed as close as possible to, the first. No current is passed through the second galvanometer, which acts in this respect as a dummy whose sole function is to record the zero changes. As a result of the proximity of the galvanometers, and the interrelation of their dynamical and geometrical conditions, the recording spots of light have an approximately constant separation, in spite of the fluctuations in the position of each. The current to be measured activates one of the galvanometers, and is measured by the accompanying change in the separation of the spots. The paper also describes a compensating method of observing, in which a single beam of light is reflected in succession from the mirrors of the active and dummy galvanometers so that the emergent beam tends to remain stationary.

AUTHOR.

274. Kathode-Ray Interference Apparatus. F. Kirchner. *Phys. Zeits.* 31. *pp.* 772–773, *Aug.* 15, 1930.—A description is given of the construction of a kathode ray interference apparatus designed for demonstration purposes and for investigating the structure of materials. It consists of a cylindrical discharge tube about 20 cm. long and 2·5 cm. diameter with plane aluminium kathode. The kathode beam passes out through two small holes, one behind the other and of diameters 0·2 and 0·1 mm. respectively, into the observation chamber, which consists of a copper tube about 25 cm. long and 7 cm. diameter. The substance under investigation is placed a little distance away from the second hole through which the kathode beam passes. A discharge current of 0·1 mA. with an applied voltage of 30 to 50 kV. is sufficient for most purposes. A number of examples are given of photographs obtained with the apparatus. A. W.

275. Electromagnet of the University of Leyden. G. Häder. *Siemens Zeits.* 10. *pp.* 481–485, *Aug.*, 1930.—A description of the huge electromagnet, with illustrations, installed at the University of Leyden by Siemens and Halske. Full specifications are given. The apparatus affords unique facilities for the study of diamagnetism, ferromagnetism and paramagnetism, as well as for experimental work connected with electrons and their behaviour in high magnetic fields, as also kathode and light rays. With a polar distance of 1·2 mm. and with polar end pieces of area corresponding to a diameter of 1·8 mm., a field strength of 66,200 gauss was obtained. Full details and specifications of the accumulator battery, the magnet windings and other parts used are included. S. G. B.

276. Amplifier for Measuring Small Currents. R. D. Bennett. *Rev. Sci. Instruments*, 1. *pp.* 466–472, *Aug.*, 1930.—An amplifier is described which uses a 4-electrode valve of the ordinary type, and gives maximum current sensitivities of the order of 10^{-18} ampere. A novel feature consists in using as grid leak the positive ion emission of the filament. AUTHOR.

277. Sensitive Valve Voltmeter. H. Benecke. *Zeits. f. techn. Physik*, 11. 9. *pp.* 361–363, 1930.—A voltmeter of the thermionic valve type is described, which has a linear characteristic and may be used with a pointer instrument, to measure fractions of a microvolt. Its use with a Wheatstone's bridge is discussed in detail. J. H. A.

278. Valve Commutator: The Production of a Periodic Pulse of Potential of Square Wave-Form. C. F. Powell and K. H. Manning. *Phys. Soc., Proc.* 42. *pp.* 563–569, *Aug.* 15, 1930.—A type of vacuum tube for producing a periodic pulse of potential of square wave-form is described. It is possible to obtain with it wave-forms in which the ratio of the duration of the pulse *t*, to the time between pulses T, is of the order of one to twenty, at a pulse frequency of a thousand. AUTHORS.

279. H.F. Oscillator for General Laboratory Use. S. F. Evans. *Journ. Sci. Instruments*, 7. *pp.* 261–263, *Aug.*, 1930.—A description of apparatus for producing oscillatory discharges of $3 \times 10^7 \sim$ per sec. AUTHOR.

280. Experimental X-Ray Tube. W. M. Roberds. *Rev. Sci. Instruments*, 1. *pp.* 473–478, *Aug.*, 1930.—An experimental tube designed for physical purposes with permanent connection with the evacuating pump and for either gas (ionic) or high vacuum electronic operation, is described and illustrated. For electron discharge operation the tube is made to run hard by means of the Hittorf effect, *i.e.* close approximation of anode and kathode and reduction of all open spaces to $\frac{1}{2}$ in. distance. The focal spot dimensions are under control. In terms of physical, as contrasted to medical, purposes, high current values can be passed *via* the tube and at 15m A. and 30 kV. Laue spots, as diffracted from calcite, can be obtained in half an hour. B. J. L.

RADIOGRAPHY AND ELECTROPHYSIOLOGY

281. Report of Irish Radium Committee (Royal Dublin Society) for Year 1929. *Roy. Dublin Soc., Proc.* 19. *pp.* 475–489, *Aug.*, 1930.

282. Construction of a Heavy-Current Mercury-Vapour Lamp. T. Asada. *Phys. Math. Soc. Japan, Proc.* 12. *pp.* 167–170, *July*, 1930. *In German.*—Describes the constructional details of a heavy-duty quartz mercury-vapour lamp, of arc-length 7 cm., internal tube diameter about 1 cm. and current capacity 20 amps. The chief difficulty is that of cooling the container, and details are given of the (radiator) cooling of the kathode end and of the water-flow cooling of the anode. G. E. B.

283. Comparison of Biological Effectiveness of the Radiations from a Mercury-Vapour Lamp and from Two Arc Lamps by means of a Screened Photoelectric Cell. T. C. Angus. *Brit. J. of Radiology*, 3. *pp.* 320–322, *July*, 1930.—Comparison was made of the radiation from a new mercury-vapour lamp and two open carbon arc lamps, the intensity being measured by a cadmium photoelectric cell. The exposures were made at varying distances and are therefore difficult to interpret, but, in the case of a test at equal distance upon a human subject, the production of erythema at equal distances was approximately equal. Photoelectric measurements gave relative intensities of the mercury-vapour arc as 3·37 and of the carbon arcs as 3·54 and 1·00. B. J. L.

284. Reaction of Untanned Skin to Ultra-Violet Radiation. M. Luckiesh, L. L. Holladay and A. H. Taylor. *J.O.S.A.* 20. *pp.* 423–432, *Aug.*, 1930.—Three white human subjects, one of blonde type, one of brunette type and one of intermediate type, were exposed to radiation from two types of mercury-vapour lamp. The reflective powers of the skins, as measured by a Taylor reflectometer, were found to be 51, 48, and 52 % respectively. Details are given of the distribution of the intensity in the lamp spectra and details in terms of foot-candle minutes, of the

doses required to produce erythema. It was found the average value, in terms of microwatt-seconds, required to produce erythema upon the three subjects were, 4305, 5015 and 3620 respectively, giving average ratios of sensitivity of 100, 86 and 119. B.J.L.

285. Quantitative Biological Effects of Monochromatic Ultra-Violet Light. I. Weinstein. *J.O.S.A.* 20. *pp.* 433–456, *Aug.*, 1930.—The lack of quantitative measurement in the literature, both experimental and clinical, is commented upon. The history of the subject is then very fully discussed since 1877 to date. Details are then given of experiments in which care was taken that error did not arise owing to use of bacteria and protozoa at different stages of their life cycles, in different media, and in which the wave-length of the light and its energy were carefully measured. As experimental subjects paramecia micromultinucleata were used and their method of culture is closely described. The source of radiation was a mercury-vapour lamp and the radiation intensity was measured by a Bi-Ag thermopile. The action upon the paramecia was first of a stimulative nature, as shown by increased locomotion, followed by vacuolization of the protoplasm and death. The measurements are dealt with from a mathematical aspect. Results show the Bunsen and Roscoe law was obeyed as well as the Grotthus law. It is established that factors other than total incident energy play a part, one factor being the frequency, wave-lengths below 3000 Å. being more greatly absorbed and hence being relatively more effective. Within the range of the intensities employed, the incident radiation intensity for a given wave-length, multiplied by the time for a lethal action, equals a constant. Radiation given over intervals, if the intervals are not excessive, is cumulative. The theories of the mechanism of biological action of ultra-violet light are cited. Very full references to other investigators are given throughout the paper. B. J. L.

286. Instruments for Measuring Ultra-Violet Radiation and the Unit of Dosage in Ultra-Violet Therapy. W. W. Coblentz. *Brit. J. of Radiology.* 3. *pp.* 354–363, *Aug.*, 1930.—An account of the main characteristics of various forms of ultra-violet dosemeters, *e.g.*, pastilles of zinc sulphide, photoelectric cells, bleaching of methyl blue, with a view to their use by the therapist. Alternatively a non-selective radiometer may be used in conjunction with suitable filters to limit the effective radiation to the region near 0·32 Å.; this method has the advantage that more accurate calibration is possible. Experience suggests that a patient suitably exposed to the solar ultra-violet radiation receives at 0·31 Å. about 0·001 gm. cal. per min., and it is suggested that a suitable unit (suggested name "Finsen unit") would be 0·001 gm. cal. per sq. cm. per min. G. E. B.

287. Modern Developments in X-Ray Therapeutic Technique. W. M. Levitt. *Brit. J. of Radiology*, 3. *pp.* 304–311; *Disc.*, 311–315, *July*, 1930.—A review of X-ray therapy, chiefly in relation to deep therapy. Whilst no new information is given, the account is accurate and easily appreciated. An extended *Discussion* followed. B. J. L.

288. Emission of X-Rays by Rectifying Valves. G. E. Bell. *Brit. J. of Radiology*, 3. *pp.* 364–368; *Disc.*, 371–374, *Aug.*, 1930.—It is shown that, assuming the valve action to be purely thermionic, the voltage across a rectifying valve is small until the instantaneous value of the

current approaches very near to the saturation current of the valve. Thus there should be no danger of X-ray emission until the current approaches this saturation value. This conclusion holds when the valve supplies a hot-kathode tube, but it is not necessarily true in the case of gas tubes. In the *Discussion* it was suggested that the trouble was more serious than this, and that a high potential and consequent emission of X-rays may be aggravated by the presence of traces of gas in the valve. G. E. B.

289. Thermionic Rectification of X-Ray Circuits. R. S. Wright. *Brit. J. of Radiology*, 3. *pp.* 369–371; *Disc.*, 371–374, *Aug.*, 1930.—A discussion of half-wave and full-wave rectification, with special reference to the current through the rectifying valves. It is stated that if the filament current is sufficiently high there is no danger of X-ray emission from the valves. The author is of the opinion that it is better to measure and maintain constant the filament current rather than the filament voltage. G. E. B.

290. Strobanœsthesia. R. Heilbrun and A. Makower. *Phys. Zeits.* 31. *pp.* 623–625, *July* 1, 1930.—If, via condensers, two human subjects are connected to a.c. mains and a current of 10^{-5} to 10^{-3} ampere passes, they experience, on touching hands, an agreeable feeling of adhesion. If, however, they make mutual intermittent contact, they experience a sensation as though the skin had corrugations. By means of lycopodium powder placed upon the skin an actual striped appearance is obtained, and similar appearances may be obtained on inert conductors such as slate, leather, bone, etc. The production of these effects appears to be based upon the Johnson-Rahbeck effect between semi-conductors. Owing to the analogy to stroboscopic representations, the authors have given the name of strobanœsthesia to the effect. B. J. L.

291. Resistance of the Human Body to H.F. Currents during Diathermy Treatment. W. E. Schmid. *Arch. f. Elektrot.* 24. *pp.* 202–215, *Aug.* 23, 1930.—Gildemeister has advanced a theory of conduction of h.f. (diathermy) current *via* the human subject based upon consideration of the human body as an electrolytic cell and having regard to the effect of capacity as regards the phase relationships. As opposed to this view, O. Muller considers that only ohmic resistance enters into consideration and, to support this, points out that, if a human subject is replaced by a carbon-filament lamp of equal resistance, the circuit characteristics are still such as to indicate that the effect of the human body is merely ohmic. In the present investigations the differential arrangement previously used by Hausrath and Hund was adopted, as this is largely free from effects due to capacity towards the earth. This circuit is similar to the diathermy apparatus circuit, except that, for purposes of variation and tuning, the capacities are variable. Experiments were carried out upon the elbow, upper leg and hands of various patients, and liquid resistances were used for purposes of comparison. The mathematical characteristics of the circuits are discussed, as well as the effect of capacity to earth. From the practical results the author concludes that the action of the human body in diathermy circuits is essentially of a purely ohmic nature. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

292. Sorption of Water Vapour by Cellulose and Its Derivatives. Part II. Kinetics of Sorption. S. E. Sheppard and P. T. Newsome. *J. Phys. Chem.* 34. *pp.* 1158–1165, *June*, 1930.—The results now given were obtained [see Abstract 2026 (1930)] with pieces of cellulose acetate and nitrate sheets, which can be prepared of definite thickness, so that the coarser structure factors present with fibres and powders are minimised. Even so, a very definite porosity factor is revealed. The diffusion law is more nearly followed for thick sheets, which give greater constancy for the diffusion constant k, the marked variation of the latter with thickness indicating a structural difference. The rate of sorption depends primarily on diffusion, but the value of a, the half-thickness of the sheet, is affected by a structure factor of porosity so that it does not correspond accurately with the geometric value. The sorption exhibits two principal stages or aspects, one consisting in the attachment of water (or other polar) molecules to free hydroxyls of the cellulose molecule, only a certain number of the hydroxyls being free to exert this attraction. A considerable but variable proportion of the water adsorbed is held under varying constraint and evidently corresponds with liquid in pores or capillary spaces. The movement of water through a cellulose gel is mainly a random molecular movement, but it is complicated by secondary anchorages of water molecules, which cause local flooding and surging. T. H. P.

293. State of Dispersion of Cellulose in Cuprammonium Solvent. A. J. Stamm. *Am. Chem. Soc., J.* 52. *pp.* 3047–3062, *Aug.*, 1930.—The dispersion of pure cotton linters α-cellulose in cuprammonium solvent was studied by the aid of the ultracentrifuge. The cellulose was shown to be a monodisperse and had a molecular weight of $55{,}000 \pm 7000$. On a copper free basis it was $40{,}000 \pm 5000$. The particles were, therefore, made up of 200 to 260 $C_6H_{10}O_5$ units. Atmospheric oxygen was shown to exert a degrading action on the solution by decreasing the particle size. The cuprammonium solvent was shown to contain some colloidally dispersed particles. Their sedimentation velocity ranged from ten to several hundred times that of the cellulose particles. Their sizes ranged from $6{\cdot}5$ mμ to more than $20{\cdot}0$ mμ in diameter. Cellulose xanthogenate dissolved in dilute alkaline solution had approximately the same molecular weight as the above cellulose. F. J. B.

294. Determination of the Number of Particles in Sols by Counting in the Ultramicroscope. G. Wiegner and E. W. Russell. *Kolloid Zeits.* 52. *pp.* 189–201, *Aug.*, 1930.—Results are given of a thorough investigation into the technique of counting colloid particles in the Siedentopf-Zsigmondy slit ultramicroscope, particularly with gold sols. It is shown to be more accurate to count all the eighteen squares of the eyepiece micrometer one after the other than to count merely a single square. The counts in successive squares are independent of the result of the previous counting, which is probably not the case when always the same square is counted. If the whole 18 squares are counted, the order of counting has no influence on the result. Working on these lines, different observers obtain in general the same number of particles in one and the same gold solution. The accuracy of the value obtained is influenced: (1) By the degree of polydispersivity of the gold solution. If the system is

highly polydisperse, only a portion of the ultramicrons present are counted. (2) By varying the brightness of the field. If the field is too bright, it becomes very difficult to count the smaller particles accurately. If M particles are found in N squares, so that the mean number m per square is M: N, the best method to calculate the mean error of m is by the formula $m \pm \frac{\sqrt{M}}{N}$ or $m \pm \sqrt{\frac{m}{N}}$. With gold sols the number of particles to be counted should not exceed 0·6 per square if the particles are small. With large particles, *e.g.* gold ultramicrons of over 30 $\mu\mu$ radius, the number should be less than 0·6 per square. The factor limiting the determination of the absolute number of particles in unit volume of the system is the uncertainty in ascertaining the illuminated volume in the cell. It is found possible to focus conveniently a volume of 729 μ^3, but not to assert how accurately this focussing can be carried out; a possible error of 10–15 % seems likely. T. H. P.

295. Stability of Unimolecular Films. Part IV. C. G. Lyons and E. K. Rideal. *Roy. Soc., Proc.* 128. *pp.* 468–473, *Aug.* 5, 1930.—By methods previously described [see Abstract 3223 (1929)] the area per molecule in the solid condensed film of heptadecylamine is found to increase from 20·5 to 26·2 Å.^{2} per mol. within a temperature interval of 3–4° at about 12–15°, the temperature varying with the pH of the solution on which the film is spread. Octadecylamine hydrochloride shows an area of 20·5 Å.^{2} except on borate solutions of pH8·8 — 9·6, on which its behaviour resembles that of free heptadecylamine. Adam's results [see Abstract 2678 (1930)] are confirmed, differences being due to different conditions of experiment, except that octadecylamine hydrochloride is now found to give 20·5 Å.^{2} per mol. on M/20 as well as on M/1000 phosphate solutions, the free base giving uniformly 26·2 Å.^{2}, due, it is suggested, to formation of phosphate of the base. These results are consistent with there being two stable solid films formed by these amines and their salts, consisting of molecules tilted till the chains interlock after displacements of one (20·5 Å.^{2}) and two (26·2 Å.^{2}) zigzags respectively. C. A. S.

296. Polymolecular Films. R. S. Bradley. *Phil. Mag.* 10. *pp.* 323–327, *Aug.*, 1930.—Smits has obtained polymolecular layers of mercuric oxide on glass 500 molecules thick at 300° C. and J. W. Smith [see Abstract 316 (1929)] thick layers of water and benzene on amalgamated platinum. Since the range of surface forces is small, the formation of such films must be due to interaction between adsorbed molecules and a mathematical study is now made of interaction caused by electric polarisation. It is found that, instead of giving a thick film, the concentration of adsorbed molecules diminishes approximately exponentially with the distance. The calculation is limited to the case of a dipole chain. H. H. Ho.

297. X-Ray Determination of the Solubility of Copper in Silver. N. Ageew and G. Sachs. *Zeits. f. Physik*, 63. 5–6. *pp.* 293–303, 1930.—The earlier precision measurements of the lattice constants of Ag and Cu [see Abstract 2955 (1930)] have been extended to their alloys in order to determine the limits of the solid solubility of Cu in Ag. The lattice constants have been measured with an accuracy of approximately ± 0·025 %. The results are tabulated over the range of temperature of 100° C.–700° C. F. J. W.

298. X-Ray Study of Au-Cu Alloys. K. Ohshima and G. Sachs. *Zeits. f. Physik*, 63. 3-4. *pp.* 210-223, 1930.—At high temperatures copper and gold form a continuous series of mixed crystals with regular face-centred lattices. Below 400° C. two kinds of crystals appear, regarded as AuCu and $AuCu_3$. The lattice of the former is tetragonal, the latter retains the cubic arrangement. This decomposition of the mixed crystals can be suppressed by quenching and restored by reheating. In that case the AuCu is metallurgically improved [see Nowack, Abstract 1447B (1930)]. As to $AuCu_3$ there is no evidence in that respect. The authors give particulars of seven Debye-radiograms of wires of the alloy (75·2% Au, 24·8% Cu by weight) quenched from 600° under different conditions and reheated 250° or less. The experimental arrangements were previously described [see Abstract 2335 (1930)]. The transition may, according to Gorsky [see Abstract 3162 (1928)] be regarded as a variation of the axial ratios which may be spontaneous all through the mass, or be connected with germ growth, or follow a statistical law as in radioactive decay. This last kinetic change, which would be similar to the γ-α transformation of iron, appears the most likely. At moderately high temperatures there is possibly an intermediate stage between mixed crystals and compound. The research is being continued. H. B.

299. Nature of the β-Transformation of Copper-Tin Alloys. Part I. H. Imai and I. Obinata. *Ryojun Coll. Eng., Mem.* 3. 2*c*. *pp.* 117–135, *Aug.*, 1930. *In German.*—The change of the eutectoid decomposition of the β-copper-tin mixed crystals was followed by means of resistance-temperature measurements as well as differential thermal curves. The measurements were made on samples which had been annealed, and on quenched samples. The effect of the rate of cooling on the structure was also determined. At least three stages in the decomposition were recognised. The transition at 590° C. was considered to be a change allied to the A_2-transition of iron and to the β-change in the copper-zinc alloys. F. J. B.

300. Theory of Plastic Deformations of Ductile Metals. A. Nadai. *Phys. Rev.* 36. *pp.* 762 772, *Aug.* 15, 1930.—A brief account is given of the principal conditions which are available to express the equilibrium of stress in the plastic state of ductile metals. These conditions are discussed for the case of rotationary symmetry in a plastic body. As an example several cases of plastic flow in a thick-walled cylinder subjected to high internal pressure with and without longitudinal expansion are treated. The distribution of stress during yielding is given for a long cylinder and for a flat ring, both subjected to radial pressure. How yielding and the plastic deformation spread through the walls of the cylinder have been shown. AUTHOR.

301. Formation of Molecular Hydrogen from Atoms. H. Senftleben and O. Riechemeier. *Ann. d. Physik*, 6. 1. *pp.* 105–128, *Aug.* 6, 1930.—The degree of dissociation of gaseous molecules is determined quantitatively from measurements of the thermal conductivity. Dissociation of hydrogen molecules by irradiation, in the presence of mercury vapour, with light from a mercury-vapour lamp raises the thermal conductivity, which rapidly attains a constant value under a given pressure. As soon as irradiation ceases, recombination of atoms causes a slow fall in the conductivity. By suitable procedure it is possible to eliminate almost entirely the effect of reactions occurring on the walls of the vessel.

Analysis of the results under these conditions shows that the recombination of atoms in the gas space proceeds by triple impacts between three atoms and also between pairs of atoms and a molecule. Probability considerations based on the thermal conductivity changes give a value for the effective atomic diameter in impact between two atoms and a molecule of the same order of magnitude as that deduced from the kinetic theory of gases. In the case of impacts between three atoms the value obtained is about four times as great as that deduced from kinetic theory. A. J. M.

302. Explosive Antimony. H. v. Steinwehr and A. Schulze. *Zeits. f. Physik*, 63. 11–12. *pp.* 815–823, 1930. *From the Reichsanstalt.*—For ascertaining the character of explosive antimony, experiments are now described which partly confirm previous investigations and partly afford new data. In the latter respect, structural analysis by means of X-rays has shown that explosive antimony exists in the amorphous state, a fact which hitherto could only be an assumption. H. H. Ho.

303. Energy Value of the Decomposition of Chloroform by X-Rays and the Mechanism of this and Analogous Reactions. G. Cronheim and P. Günther. *Zeits. f. phys. Chem.* 9. *Abt. B.* 3. *pp.* 201–228, *Aug.*, 1930.—As previously shown by Günther and others, chloroform evolves hydrochloric acid on treatment with X-rays. The present work deals with the relationship between the quantity of hydrochloric acid evolved and energy of X-rays as well as the reaction process. Reference is made to the work of Glocker [see Abstract 2202 (1929)], who pointed out that chemical reactivity in so far as X-rays are concerned is dependent on the photo- and Compton-electrons and not on the number of unit quanta. It is now shown that the quantity of hydrochloric acid produced is proportional to the incident X-ray energy. To produce one molecule of hydrochloric acid from pure chloroform it is necessary that the energy of the X-rays be 21 k.-cal. with reference to secondary electrons. Several schematic chain reactions illustrating the production of hydrochloric acid from chloroform are proposed. It is observed that chlorine monoxide is also produced. J. K.

304. Thermodynamics of the Haber Equilibrium. L. J. Gillespie and J. A. Beattie. *Phys. Rev.* 36. *pp.* 743–753, *Aug.* 15, 1930.—All of the equilibrium data on the ammonia synthesis reaction, which cover an extreme temperature range of from 325° to 952° C. and an extreme pressure range (at some temperatures) of from 10 to 1000 atmospheres, are correlated with the compressibility and heat capacity data on the pure reacting gases by means of a rational and relatively simple equation for the mass action function K_p. In this equation the effects of temperature and of pressure on K_p are separated, the relation for the temperature effect being exact, but certain approximations being introduced for the sake of simplicity into the relation for the pressure effect. All of the data on the ammonia synthesis equilibrium are represented within the experimental accuracy by the use of only two adjustable constants. AUTHORS.

305. Comparison of Electrolytic Resistances with H.F. Currents. A. Deubner. *Ann. d. Physik*, 5. 3. *pp.* 305–324, *June* 10, 1930.—A method is described by which electrolyte conductivities can be compared at a frequency of 10^7 per sec. with an accuracy of $\pm$ 0·03 % if the solutions have neutral reactions. In the arrangement the damping action of the electrolyte resistance, which is placed parallel to the condenser of an

oscillation circuit is somewhat overcompensated by a back-coupled valve. The intensity of the resulting weak oscillation, which is very sensitive to small changes of the electrolyte resistance, is measured with a detector circuit. The results of measurements with $CaSO_4$ and HCl solutions are given. Those on $CaSO_4$ show that for the observed dispersion effects the Debye-Falkenhagen relaxation phenomena of the ion atmospheres are answerable. $CuSO_4$ solutions give the same curves as $CaSO_4$ solutions. It was found that on mixing equally conducting, about 0·01 *N*, solutions of NaCl and $CuSO_4$, an increase of conductivity with low frequency occurred of about 5 %. J. J. S.

306. Electrical Conductivity of Butyric Acid-Water Mixtures. J. Grindley and C. R. Bury. *Chem. Soc., J. pp.* 1665–1668, *July*, 1930. —Determinations of the conductivity of butyric acid-water mixtures show that it increases in accordance with the dilution law over a range of concentration, 0 to 12 % acid. The agreement is qualitative only. The conductivity-concentration curves show a well-marked maximum at about 12 % acid. When the mixtures contain less than 15 % water, low conductivities are observed. The conductivity rises rapidly when the concentration of the water exceeds 25 %. F. J. B.

307. Electrical Conductance of Cobalt Sulphate Solutions. R. C. Cantelo and A. J. Berger. *Am. Chem. Soc., J.* 52. *pp.* 2648–2653, *July*, 1930.—Measurements of the conductance of aqueous cobalt sulphate solutions at concentrations 0·0001 to 0·5 N at 25° C. give a value of 1·58 for the exponent n in the equation $\Lambda = \Lambda_0 - (\Lambda^n C^{n-1})/(K\Lambda_0^{n-1})$. By extrapolation Λ_0, the equivalent conductance of a solution of zero concentration, is 134·6 mhos. The relative viscosities of the same solution are determined and the conductance—viscosity ratios calculated. A. J. M.

308. Specific Conductance of Liquid Hydrogen Sulphide. S. D. Satwalekar, L. W. Butler and J. A. Wilkinson. *Am. Chem. Soc., J.* 52. *pp.* 3045–3047, *Aug.*, 1930.—The conductivity of liquid hydrogen sulphide was determined with great care in order to obtain more concordant values than those published. The determinations were made at different voltages from 1·5 to 19·25 volts at a temperature of − 78·5° C. The specific conductivity of liquid hydrogen sulphide was found to be $3{\cdot}7 \times 10^{-11}$ mhos, at − 78·5° C. Small quantities of water were found to produce a very great increase in the resistance. F. J. B.

309. Conductivity and Density of Chromic Acid Solutions. H. R. Moore and W. Blum. *Bureau of Standards, J. of Research*, 5. *pp.* 255–264, *Aug.*, 1930.—The conductivity and density of chromic acid solutions were determined for concentrations up to 10 molar (1000 *g/l* of CrO_3). The density is practically a linear function of concentration. The conductivity increases to a maximum at about 5 molar and then decreases. AUTHORS.

310. Electrodeposition of Metals from their Liquid Ammonia Solutions. R. Taft and H. Barham. *J. Phys. Chem.* 34. *pp.* 929–953, *May*, 1930.—The electrodeposition of lead, silver, copper, cadmium, nickel and chromium from solution in liquid ammonia is studied. The deposits obtained are compared with those obtained from aqueous solutions. The best deposits are obtained by a lower current density from liquid ammonia solutions than is required for aqueous solutions. The concentrations for the best deposits are approximately the same for lead, cadmium and

silver as in water solutions; for the other three the concentrations are lower in liquid ammonia solutions than in water solutions. The difference of solutions in liquid ammonia is due to their greater fluidity. The technical application of liquid ammonia solutions for the electrodeposition of lead and cadmium is considered possible. F. J. B.

311. Acetamide and Formamide as Solvents for the Electrodeposition of Metals. L. F. Yntema and L. F. Audrieth. *Am. Chem. Soc., J.* 52. *pp.* 2693–2698, *July*, 1930.—The substitution of the OH-group by an amide-group in formic and acetic acids increases the dielectric constant and the solvent power. Formamide is miscible with alcohol, very slightly soluble in ether, and gives metallic compounds corresponding to hydroxides. It is an excellent dissociating solvent; molar conductivities are smaller than with water. When sodium formamide is dissolved in formamide, both the solvent and the solute ion gain the anion $HCONH^-$ which has a low ionic mobility. The metallic derivatives of acetamide are unstable in water, but stable in liquid ammonia; numerous addition compounds are formed. Zinc, cadmium, lead, tin, cobalt and nickel were deposited from solutions of their salts (cyanides, nitrates, chlorides, etc.) with platinum anodes and copper kathodes, at current densities ranging from 0·02 to 0·06 amp./cm.^{2}; previous experiments had been made by Röhler [see Abstract 1172 (1910)]. Thallium is deposited from acetamide solutions, like the other metals. All the experiments were made at 100° C.; separations are not mentioned. H. B.

312. Cataphoretic Measurements and Theory of Critical Potential. D. R. Briggs. *J. Phys. Chem.* 34. *pp.* 1326–1352, *June*, 1930.—A series of measurements of cataphoretic velocity is made on samples of several sols to which varying amounts of different types of electrolytes were added. The cataphoretic velocity is determined at five or six concentrations for each electrolyte and for each sol. The sols were arsenic trisulphide, gold, selenium and silver. The electrolytes were new fuchsine chloride, strychnine nitrate, barium chloride, potassium chloride, aluminium chloride and potasssium nitrate. The results are discussed from the standpoint of stabilisation and critical potential. F. J. B.

313. Irregular Cataphoresis with Protein-Methylene Blue Adsorption and the Hydrone Theory. A. Fodor. *Kolloid Zeits.* 52. *pp.* 81–87, *July*, 1930.—When proteins adsorb methylene blue there may or may not be spectrophotometric evidence of the adsorption, and the particle may migrate to the anode or the kathode. The behaviour of alkaline and acid gelations is particularly difficult to explain [see Abstract 1344 (1929)]. The peculiarities cannot simply be ascribed to a charge reversal by adsorbed ions, nor to complex salt formation. The migrating particles may be free ions and not colloidal. The author finds the explanation in hydration and by sorption and distinguishes between enhydrones and ekhydrones. The former are micellar systems in which water films cover the colloid with their two ions. In the latter the ions are those of salts. Whether the cell boundary is permeable to ions depends upon the state of hydration. Albumen has two such states. Coarse particles are penetrated by the positive methylene blue ion under partial destruction of the enhydrone layer. When methylene blue-chlorine (MBl^+-Cl^-)ions pass through the ekhydrone layer there is no charge reversal nor destruction. Not all colloids will behave like proteins. It is improbable that coarse

particles of heavy mass (kaolin) will, when charged, be dragged to the electrode which corresponds to the free ion. H. B.

314. Action of Wehnelt's Interrupter and Crystalline Conductivity. S. Ray. *Zeits. f. Elektrochem.* 36. *pp.* 425–427, *July*, 1930.—Considers the " quasi-crystalline " structure of solutions due to the cataphoretic charges on the particles of the solute and those of the solvent. The forces between the two sets of particles are of the same nature as those between the particles of a crystal, and the author shows that if there is an electric field a periodic vibration of the centre of gravity of the dissolved mass will result; in other words, two continua are present, one of which oscillates with respect to the other. There is thus an oscillatory cataphoretic current, and on this is superimposed a dissociation current in one direction. If the absolute maximum of the oscillatory current is equal to the constant value of the dissociation current the resultant current will be in one direction only, and in interrupted current will result. This is apparently what takes place in the Wehnelt current interrupter, and explains the rectification produced by crystals. H. N. A.

315. Thermodynamics of Ionic Solvation. E. Lange and K. P. Mišščenko. *Zeits. f. phys. Chem.* 149. *Abt. A.* 1–2. *pp.* 1–41, *July*, 1930.—For the stricter interpretation of the energy and heat effects accompanying the solvation of gaseous ions, the influence of the chemical and electrostatic properties of the phases is considered. The liquid phase is determined in relation to its excess charge by a ψ-potential, and in relation to the electrical structure of the surface by some χ-potential. For the transition from an idealised gaseous state of ions (or electrons) to the liquid phase, three cases are distinguished: (1) $\psi = 0$, $\chi = 0$: pure chemical solvation effects; (2) $\psi = 0$, $\chi \neq 0$: real solvation effects; and (3) $\psi \neq 0$, $\chi \neq 0$: electrochemical solvation effects. The sum of the solvation effects of oppositely charged ions or the difference for similarly charged ions is considered with respect to their dependence on electrical influences, and the possibility of judging of the separate values of chemical solvation heats from these sums or differences is discussed. The heat of solvation is thus related to Galvani and Volta potentials, and the relationship between the surface potentials and the distribution coefficients of an electrolyte in two non-miscible solvents is investigated. T. H. P.

316. Entropy of Ions and Solvation. H. Ulich. *Zeits. f. Elektrochem.* 36. *pp.* 497–506, *Aug.*, 1930.—The entropy of ions is defined and a method for calculating it is developed. The standard entropies for a number of ions in aqueous solution are calculated. It is shown that the hydration numbers of monatomic ions can be calculated by a new method, and that these numbers agree with those calculated from the ionic mobilities. The connection between the partial ionic entropies and the ionic mobilities permits the calculation of either of these values from each of them. The available data on heat and work for non-aqueous solutions is too meagre to decide whether the connection holds for these solutions. F. J. B.

317. Activity Coefficients of Ions in Dilute Solution in Ethyl Alcohol-Water Mixtures. L. A. Hansen and J. W. Williams. *Am. Chem. Soc., J.* 52. *pp.* 2759–2767, *July*, 1930.—The Debye and Hückel equations were tested by determinations of the activity coefficients of slightly soluble complex cobalt ammine salts of valency types 1–1, 1–2 and 3–1. The general ideal equations of the interionic attraction theory are obeyed in those solvents having dielectric constants as low as one-half

that of water, for salts of the valency types 1–1 and 1–2, provided that the solutions were sufficiently dilute. The salts of the valency type 3–1 studied showed a marked deviation from the simple limiting law, when the dielectric constant of the solvent was reduced below that of water by an appreciable amount. The deviation was accounted for qualitatively but not quantitatively. F. J. B.

318. Diffusion Potentials. V. Plettig. *Ann. d. Physik*, 5. 6. *pp.* 735–761, *July* 7, 1930.—The diffusion potential and the concentrations of the separate ions at different positions in the transition stratum are calculated for the cells 1·0 HCl/0·01 KCl, 1·0 HCl/0·01 LiCl, 0·1 H_2SO_4/0·01 Li_2SO_4, according to the theories of Planck and Henderson, and the effect on the total potential of interposing mixtures of these concentrations according to the two theories is deduced. Experimental investigation of boundary strata produced in various ways confirms Henderson's formula. A. J. M.

319. Application of Diffusion Coefficients to Determination of Molecular Weights. G. Jander and A. Winkel. *Zeits. f. phys. Chem.* 149. *Abt. A.* 1–2. *pp.* 97–122, *July*, 1930.—The determination of molecular weights from diffusion coefficients was investigated. The behaviour of amphoteric electrolytes which result from the solution of weak acids, such as silicic, stannic, antimonic, molybdic, tungstic acids and other amphoteric oxyhydrates was investigated. It was found that a connection existed between the diffusion coefficient and the charge on the ion. A very fair agreement was obtained between the calculated molecular weight and that derived from the diffusion coefficients for a series of electrolytes and non-electrolytes. F. J. B.

320. Potential Effect in Solutions of Electrolytes in Acetone. F. Bauer. *Ann. d. Physik*, 6. 2. *pp.* 253–272, *Aug.* 16, 1930.—The theory of the potential effect in electrolytes [see Abstract 2641 (1929)] implies a connection between the effect and the viscosity and dielectric constant of the solvent. The investigation of the theory is therefore extended to solutions in acetone, which has a much smaller dielectric constant than water. Only 1·1 — and 1·2 — valent salts give the required solubility and conductivity in acetone. The presence of small amounts of water has no appreciable effect on the phenomenon. In general the results are similar to those for aqueous solutions, but in the equation relating change of conductivity with field strength X, $\Delta\lambda_v = AX^2(1 - BX^2)$, A is greater and B smaller than in water, in accordance with the theory, though accurate quantitative agreement is not attained. In acetone a limiting value for conductivity with increasing field strength is only obtained readily with the solution of potassium iodide, in which it is found that this limit effect and the concentration effect are of the same order of magnitude. A. J. M.

321. Electrolytic Dissociation in Nitric Acid. I. R. Rao. *K. Akad. Amsterdam, Proc.* 33. 6. *pp.* 632–643, 1930.—A repetition and extension of experiments previously described [see Abstract 3905 (1930)]. The Raman spectra of nitric acid in different concentrations are recorded, and the change in intensity of lines due to HNO_3 and NO_3^- compared. In the present experiments, more accurate intensity measurements are made, so as to settle the degree of dissociation at different concentrations. It is concluded that the dissociation at higher dilutions is greater than that calculated from viscosity-conductivity data. A. C. M.

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